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NATIONAL PARK SERVICE  
WATER RESOURCES  
FORT COLLINS, CO.  
RESOURCE ROOM PROPERTY

Professional  
Service  
Industries, Inc.





**Professional Service Industries, Inc.**  
Environmental Management Group

June 29, 1993  
Project No. 513-34074

TO: National Park Service  
12795 West Alameda Parkway  
Denver, Colorado 80225

Attention: Mr. Carl Wang

SUBJECT: Indefinite Quantities Contract No. CX-2000-1-0022, Task Order  
Number 11, Charleston Harbor Site, Review Remedial  
Investigation/Feasibility Study (RI/FS) Plan, Fort Sumter National  
Monument, South Carolina, FOSU-105A-15A

Dear Mr. Wang:

In accordance with the National Park Service's (NPS) request as outlined in Task Order Number 11, Professional Service Industries, Inc. (PSI) Environmental Management Group has reviewed Chester Environmental's "Calhoun Park Area Site RI/FS Work Plan, Charleston, South Carolina", dated April 17, 1993, Report Number 371901-02.

PSI's comments from the review of the RI/FS Work Plan are arranged by the section that they appear in the report.


**Section 1.0 Introduction**

- No comments

NATIONAL PARK SERVICE  
WATER RESOURCES DIVISION  
FORT SUMTER NATIONAL MONUMENT  
RECORDS MANAGEMENT

**Section 2.0 Site Background and Setting**

- A list of Manufactured Gas (MG) usable by-products and waste materials, in a flow chart form, would be helpful in understanding the MG process and possible waste streams.
- On Page 2-18, the report notes that a sand layer found on the South Carolina Electric and Gas (SCE&G) property was not found at the NPS property. PSI believes this information to be erroneous based upon information



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contained in the Soil Consultants, Inc. boring logs. PSI has included soil boring logs showing a sand layer on the NPS site ranging from the surface to 10 feet below ground surface (bgs) and a second sand layer ranging from approximately 39 to 50 feet below bgs. The boring logs were completed by Soil Consultants, Inc. in 1989 and 1990. PSI has no information as to the exact boring location within the NPS site or the scope of work. The boring logs were presented in General Engineering Laboratory's (GEL) Expanded Site Inspection (ESI) Report dated November 20, 1992. The boring logs are provided in Appendix A.

- In Table 2-1, the SCE&G historical land use information is not noted from 1957 to 1979.

### **Section 3.0 Initial Evaluation**

- Soil boring, PS2A, drilled by Davis & Floyd in March of 1989 is not shown on Figure 3-1.
- On page 3-21, it is noted that, "The clayey to sand silt and the Cooper Formation combined act as the upper most aquitard beneath the NPS site". While the Cooper Formation is a noted aquitard, the clayey to sand silt noted at the NPS site with a top elevation ranging from 4 to 24 feet and a depth of 80 feet, has not been shown to be an aquitard. Samples collected by GEL for the ESI indicated the presence of contaminants in the upper portion of the clayey to sand silt layer.
- On page 3-29, it is noted that, "Chester has not found information that verify the presence of this well". The well in question was noted in a 1882 drawing originally presented in "Historical Study, Sumter National Monument 'Dockside II', Charleston, South Carolina", dated December of 1987, prepared by Clark G. Reynolds. A copy of the map is provided in Appendix B.





## **Section 4.0 Work Plan Rationale**

- In Section 4.2.1, Historical Data Use, a section concerning GEL's ESI report should be added. Comments by the South Carolina Department of Health and Environmental Control (DHEC) and the Environmental Protection Agency (EPA) concerning GEL's ESI report and data are provided in Appendix C. PSI was not in the field while the GEL investigation was being completed and only has second-hand documentation of some concerns raised about the work. But PSI feels that a section noting these issues brought up by DHEC and EPA should be included in Section 4.2.1.

## **5.0 Remedial Investigation and Feasibility Study Tasks**

- On page 5-11, under the Soil Analyses section, it was noted that 20 samples will be analyzed for Polychlorinated Biphenyls (PCBs) out of the 64 samples analyzed for the other constituents. PSI would recommend that out of the 20 PCB samples, a large portion of the samples be taken from the J.W. Ludens property.
- Under the Soil Analyses section, dioxins and furans are not mentioned. PSI recommends that at least 20 soil samples be analyzed for dioxins and furans using either EPA Method 8280 or 8290.
- Concerning the Deep (D-Series) Wells section on page 5-14, PSI would recommend that a sixth D-Series well be installed on the Calhoun Park Property along Concord Street. This sixth well, when combined with the other five wells and the one deep well that the NPS is going to install on their site in the parcel to be leased to the City of Charlotte, will help give a more complete view of the sand unit underlying the clay zone.
- In Section 5.3.3.4 on page 5-16 and 5-17, it is noted that PCBs will be analyzed for in select monitoring wells. PSI recommends that the sampling be expanded to include all monitoring wells. Also dioxin and furan analysis was not





mentioned. PSI recommends that all monitoring wells be sampled and analyzed for dioxins and furans by EPA Method 8280 or 8290.

## **Section 6.0 Schedule**

- No comments

## **Section 7.0 Project Management**

- No comments

The following are general comments concerning the overall RI/FS process.

- The NPS should require that Chester Environmental provide an exact schedule of field activities so that NPS may have representatives on-site, if so desired.
- The NPS should require that all reports pertaining to this project be reviewed by the NPS or their designated representative prior to final submittal.
- The NPS should require to be copied on Chester Environmental's monthly progress reports that are to be submitted to the EPA by the fifth calendar day of every month.
- Chester Environmental should be provided all available documentation concerning the proposed construction and design of the City of Charleston Aquarium, the NPS "Dockside II", promenade and the structure planned for the George Campson property.



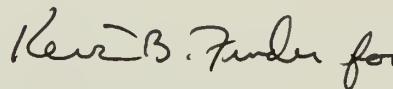
If the NPS has any questions or concerns about any of the issues raised by PSI, please do not hesitate to contact the undersigned at (404) 564-0901.

Sincerely,

PROFESSIONAL SERVICE INDUSTRIES, INC.



Geoff A. Delisio  
Project Engineer



David B. Twedell  
Vice President

GAD/DBT:tmm

nps\aquarium\review.com

cc: Steve Price, NPS, Southeast Region  
John Tucker, NPS, Fort Sumter National Monument









# SOIL CONSULTANTS, INC.

MYRTLE BEACH, S.C.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: Fort Sumter Tour Boat Facility, Cooper River, Charleston, SC

Boring No. B 1 S. C. I. Project No. 8937 Date 3-10-89

Ground Surface Elev. Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. 2'1"  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
1	0'0"	1'6"	0'0"		Medium brown fine sand with slight inorganic clay. Root, brick and gravel content. (SM W/Debris)*	5-6-9
2	2'6"	4'0"			Medium brown fine sand with brick, gravel and cinder content. (SM W/Debris)*	7-7-10
3	5'0"	6'6"		7'0"	Medium black fine sand with brick, gravel & cinder content. (SM W/Debris)*	8-20-10
4	7'6"	9'0"	7'0"		Very loose black fine sand with high cinder. (SM W/Debris)*	1-1-1
5	10'0"	11'6"		12'0"	Very loose black fine sand with high cinder. (SM W/Debris)*	1-2-2
6	12'6"	14'0"	12'0"	14'6"	Loose black fine sand with high gravel, brick and cinder. (SM W/Debris)*	2-3-4
7	15'0"	16'6"	14'6"	17'0"	Medium black organic clay with brick, gravel, cinder & creosote wood content. (CL W/Debris)*	4-4-5
8	17'6"	19'0"	17'0"		Very soft gray organic clay with slight shell and sand content. (OL)*	1-1-1
9	20'0"	21'6"			Very soft gray organic clay with slight shell & sand content. (OL)*	1-1-1
10	25'0"	26'6"			Very soft gray organic clay with slight sand & shell content. (OL)*	1/18"
11	30'0"	31'6"			Very soft gray organic clay with slight sand & shell content. (OL)*	1/18"
12	35'0"	36'6"		39'0"	Very soft gray organic clay with slight sand content. (OL)*	1/18"

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

continued

Remarks: \*VISUAL UNIFIED SOIL CLASSIFICATION  
\*\*LOCALLY CALLED MARL.

OFFSET 20' WEST BECAUSE OF LARGE CONCRETE SLAB IN AREA. TRIED 3 TIMES IN AREA. USED HOLLOW STEM FLIGHT AUGER TO 15' DEPTH AS CASING.





CHARLESTON, S.C.

SAVANNAH, GA.

MYRTLE BEACH, S.C.

## LOG of BORING

Project: Fort Sumter Tour Boat Facility, Cooper River, Charleston, SC

Boring No. B-1 (Cont.) S. C. I. Project No. 8937 Date 3-10-89 :

Ground Surface Elev. Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. 2'1"  
(Minimum of 24 hrs. after completion)

[illegible]

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \_\_\_\_\_



# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

## LOG of BORING

Project: Fort Sumter Tour Facility, Cooper River, Charleston, SC

Boring No. B-2 S. C. I. Project No. 8937 Date 3-2-89

Ground Surface Elev. Assumed 0'0" Datum Gr. Water Elev. 3'2" (Minimum of 24 hrs. after completion)

SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
From	To	From	To		
0'0"	1'6"	0'0"		Loose brown fine sand with root content.	2-2-3
			1'0"	(SM W/Root)*	
2'6"	4'0"	1'0"		Loose brown fine to coarse sand with	2-3-6
			4'6"	slight shell content. (SM-SP)*	
5'0"	6'6"	4'6"		Loose gray fine to coarse sand with	3-4-3
				creosote wood, gravel & cinder content.	
			7'0"	(SM-SP W/Debris)*	
7'6"	9'0"	7'0"		Very soft gray organic clay with high	1/18"
				gravel & slight sand content.	
			10'0"	(OL W/Debris)*	
10'0"	11'6"	10'0"		Very soft gray inorganic clay with very	1/18"
				slight sand content. (OL)*	
12'6"	14'0"			Very soft gray organic clay with very	2/18"
				slight sand content. (OL)*	
15'0"	16'6"			Very soft gray organic clay with very	1-1-1
				slight sand content. (OL)*	
17'6"	19'0"			Very soft gray organic clay with very	1/18"
				slight sand content. (OL)*	
20'0"	21'6"			Very soft gray organic clay with very	1/18"
				slight sand content. (OL)*	
25'0"	26'6"			Very soft gray organic clay with very	1/18"
				slight sand content. (OL)*	
30'0"	31'6"			Very soft gray organic clay with very	1/18"
				slight sand content. (OL)*	
35'0"	36'6"			Very soft gray organic clay with very	1-1-1
			39'6"	slight sand content. (OL)*	

and Sampling in accordance with ASTM D. 1586-67 (1974)

continued

Notes: \*VISUAL UNIFIED SOIL CLASSIFICATION

\*\*LOCALLY CALLED MARL

SHOVEL SAMPLE TAKEN ADJACENT TO BORING INDICATED VARYING ROOT CONTENT TO A DEPTH OF APPROXIMATELY 8"

USED HOLLOW STEM FLIGHT AUGER TO 12'6" DEPTH AS CASING



# SOIL CONSULTANTS, INC.

MYRTLE BEACH, S.C.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: Fort Sumter Tour Boat Facility, Cooper River, Charleston, SC

Boring No. B-1 (Cont.) S. C. I. Project No. 8937 Date 3-10-89

Ground Surface Elev. Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. 2'1"  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
13	40'0"	41'6"	39'0"	44'0"	Very loose gray fine sand. (SM)*	1-1-3
14	45'0"	46'6"	44'0"		Very soft gray organic clay with slight sand & shell content. (OL)*	1-1-1
15	50'0"	51'6"			Very soft gray organic clay with slight sand & shell content. (OL)*	1-1-2
				54'0"		
16	55'0"	56'6"	54'0"		Medium gray inorganic clay with slight sand & shell content. (CL)*	2-2-3
				59'0"		
17	60'0"	61'6"	59'0"		Stiff gray inorganic clay with slight sand content. (CL)*	3-4-5
18	65'0"	66'6"			Stiff gray inorganic clay with very slight sand content. (CL)*	3-5-5
19	70'0"	71'6"			Stiff gray inorganic clay with slight sand content. (CL)*	4-7-7
20	75'0"	76'6"			Stiff gray inorganic clay with slight sand content. (CL)*	5-7-8
				79'0"		
21	80'0"	81'6"	79'0'		Very stiff brownish green calcareous clay with slight sand content. **(MH)*	6-8-10

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_





# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA

## LOG of BORING

Project: Fort Sumter Tour Boat Facility, Cooper River, Charleston, SC

Boring No. B-2: (Cont.) S. C. I. Project No. 8937 Date 3-2-89

Ground Surface Elev. Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. 3'2"  
(Minimum of 24 hrs. after completion)

SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
From	To	From	To		
40'0"	41'6"	39'6"	44'6"	Very loose gray fine sand. (SM)*	1-1-2
45'0"	46'6"	44'6"		Very soft gray inorganic clay with	1-1-1
			50'6"	slight shell & sand content. (CL)*	
50'0"	51'6"	50'6"		Soft gray inorganic clay with slight	1-1-2
			54'0"	sand & shell content. (CL)*	
55'0"	56'6"	54'0"		Medium gray inorganic clay with slight	2-2-3
			59'6"	shell & sand content. (CL)*	
60'0"	61'6"	59'6"		Stiff inorganic clay with slight shell	3-4-6
				& sand content. (CL)*	
65'0"	66'6"			Stiff gray inorganic clay with very	3-4-5
				slight sand content. (CL)*	
70'0"	71'6"			Stiff gray inorganic clay with very	4-7-8
				slight sand content. (CL)*	
75'0"	76'6"			Stiff gray inorganic clay with slight	5-5-7
			79'6"	sand content. (CL)*	
80'0"	81'6"	79'6"		Very stiff brownish green calcareous	10-12-15
				clay with slight sand content.** (MH)*	
85'0"	86'6"			Very stiff brownish green calcareous	6-10-12
				clay with slight sand content.** (MH)*	
90'0"	91'6"			Very stiff brownish green calcareous	4-8-11
				clay w/slight sand content.** (MH)*	
95'0"	96'6"			Very stiff brownish green calcareous	6-11-11
				clay w/slight sand content.** (MH)*	
100'0"	101'6"			Very stiff brownish green calcareous	8-11-12
				clay w/slight sand content.** (MH)*	

and Sampling in accordance with ASTM D. 1586-67 (1974)

continued

\*VISUAL UNIFIED SOIL CLASSIFICATION

SHOVEL SAMPLE TAKEN ADJACENT TO BORING INDICATED VARYING  
ROOT CONTENT TO A DEPTH OF APPROXIMATELY 8".

\*\*LOCALLY CALLED MARL.



## RTLE BEACH, S.C

LOG of BORING

ng No. B-2 (Cont.) S. C. I. Project No. 8937 Date 3-2-89

Ground Surface Elev. Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. 3'2"  
(Minimum of 24 hrs. after completion)

[illegible]

ing and Sampling in accordance with ASTM D. 1586-67 (1974)

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# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

MYRTLE BEACH, S.C.

## LOG of BORING

Project: Fort Sumter Tour Boat Facility, Cooper River, Charleston, SC

Boring No. B-3 S. C. I. Project No. 8937 Date 3-7-89

Ground Surface Elev. Assumed 0'0" Datum Gr. Water Elev. 3'5"  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
1	0'0"	1'6"	0'0"		Medium brown fine sand with slight brick, gravel & root content. (SM W/Root & Debris)*	6-7-8
				2'0"		
2	2'6"	4'0"	2'0"		Loose gray fine sand with slight wood & high inorganic clay content. (SC)*	1-2-3
3	5'0"	6'6"			Loose gray fine sand with wood, gravel & high inorganic clay content. (SC W/Debris)*	2-4-4
4	7'6"	9'0"			Loose gray fine sand with slight wood, gravel & high inorganic clay content. (SC W/Debris)*	4-3-3
				9'6"		
5	10'0"	10'4"	9'6"	12'0"	Creosote Wood	50/4"
6	12'6"	14'0"	12'0"		Soft gray organic clay with creosote wood content. (OL W/Wood)*	1-1-2
				14'6"		
7	15'0"	16'6"	14'6"		Very soft gray organic clay with creosote wood content. (OL W/Wood)*	1-1-1
8	17'6"	19'0"			Very soft gray organic clay with creosote wood content. (OL W/Wood)*	1-1-1
9	20'0"	21'6"			Very soft gray organic clay with creosote wood content. (OL W/Wood)*	1/18"
10	25'0"	26'6"			Very soft gray organic clay with creosote wood content. (OL W/Wood)*	1/18"
				28'6"		
11	30'0"	31'6"	28'6"		Very soft gray organic clay with slight sand content. (OL)*	1/18"
12	35'0"	36'6"			Very soft gray organic clay with slight sand content. (OL)*	1/18"
				39'6"		

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

continued

Remarks: \*VISUAL UNIFIED SOIL CLASSIFICATION

SHOVEL SAMPLE TAKEN ADJACENT TO BORING INDICATED VARYING ROOT CONTENT TO A DEPTH OF APPROXIMATELY 4".





# SOIL CONSULTANTS, INC.

## CHARLESTON, S.C.

SAVANNAH, GA.

MYRTLE BEACH, S.C.

### LOG of BORING

Fort Sumter Tour Boat Facility, Cooper River, Charleston, SC

Project: \_\_\_\_\_ Boring No. B-3 (Cont.) S. C. I. Project No. 8937 Date 3-7-89  
 Ground Surface Elev. Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. 3'5"  
 (Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
13	40'0"	41'6"	39'6"		Medium gray fine sand with slight shell content. (SM)*	4-6-8
14	45'0"	46'6"			Medium gray fine sand. (SM)*	4-5-6
15	50'0"	51'6"	49'6"		Very soft gray inorganic clay with slight sand & shell content. (CL)*	1-1-1
16	55'0"	56'6"			Very soft gray inorganic clay with slight sand & shell content. (CL)*	1-1-1
17	60'0"	61'6"			Very soft gray inorganic clay with slight sand & shell content. (CL)*	1-1-1
				64'6"	slight sand & shell content. (CL)*	
18	65'0"	66'6"	64'6"		Stiff gray inorganic clay with very slight sand content. (CL)*	3-4-6
19	70'0"	71'6"			Stiff gray inorganic clay with very slight sand content. (CL)*	4-4-5
20	75'0"	76'6"			Stiff gray inorganic clay with very slight sand content. (CL)*	3-4-5
				79'6"	slight sand content. (CL)*	
21	80'0"	81'6"	79'6"		Very stiff brownish green calcareous clay with slight sand content. **(MH)*	6-8-9
22	85'0"	86'6"			Very stiff brownish green calcareous clay with slight sand content. **(MH)*	5-10-10
23	90'0"	91'6"			Very stiff brownish green calcareous clay with slight sand content. **(MH)*	4-8-11
24	95'0"	96'6"			Very stiff brownish green calcareous clay with slight sand content. **(MH)*	5-7-12
25	100'0"	101'6"			Very stiff brownish green calcareous clay with slight sand content. **(MH)*	6-8-13
					continued	

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

\*VISUAL UNIFIED SOIL CLASSIFICATION

Remarks: \*\*LOCALLY CALLED MARL..





CHARLESTON, S.C.

SAVANNAH, GA.

Fort Sumter Tour Boat Facility, Cooper River, Charleston, SC.

Boring No. B-3 (Cont.) S. C. I. Project No. 8937 Date 3-7-89

Ground Surface Elev. \_\_\_\_\_ Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. \_\_\_\_\_ 3'5"  
(Minimum of 24 hrs. after completion)

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

\*\*LOCALLY CALLED MARL.



# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

MYRTLE BEACH, S.C.

## LOG of BORING

Project: Fort Sumter Tour Boat Facility, Cooper River, Charleston, SC

Boring No. B-4 S. C. I. Project No. 8937 Date 3-4-89

Ground Surface Elev. Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. 2'9"  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
1	0'0"	1'6"	0'0"		Medium dark brown fine sand with brick	2-5-6
				2'0"	and root content. (SM W/Root & Debris)8	
2	2'6"	4'0"	2'0"		Loose gray fine sand with slight shell	3-3-4
					content. (SM)*	
3	5'0"	6'6"			Loose gray fine sand with slight shell	2-3-5
					content. (SM)*	
4	7'6"	9'0"			Loose gray fine sand. (SM)*	3-3-3
5	10'0"	11'6"			Loose gray fine sand. (SM)*	2-3-4
6	12'6"	14'0"			Loose gray fine sand with slight shell	2-2-2
					content. (SM)*	
7	15'0"	16'6"			Loose gray fine sand with slight shell	1-2-3
				17'0"	content. (SM)*	
8	17'6"	19'0"	17'0"		Very soft gray organic clay with slight	1/18"
					shell content. (OL)*	
9	20'0"	21'6"			Very soft gray organic clay with slight	1/18"
					shell content. (OL)*	
10	25'0"	26'6"			Very soft gray organic clay with slight	1/18
					shell content. (OL)*	
11	30'0"	31'6"			Very soft gray organic clay with slight	1/18"
					sand content. (OL)*	
12	35'0"	36'6"			Very soft gray organic clay with slight	1/18"
				39'0"	sand content. (OL)*	
13	40'0"	41'6"	39'0"		Medium gray fine sand with slight shell	4-4-7
					shell content. (SM)*	
14	45'0"	46'6"			Medium gray fine sand with slight shell	5-7-7
					content. (SM)*	

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

continued

Remarks: \*VISUAL UNIFIED SOIL CLASSIFICATION

\*\*LOCALLY CALLED MARL

SHOVEL SAMPLE TAKEN ADJACENT TO BORING INDICATED VARYING ROOT CONTENT TO A DEPTH OF APPROXIMATELY 6".

USED HOLLOW STEM FLIGHT AUGER TO 12'6" DEPTH.



Remarks: \_\_\_\_\_





# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

MYRTLE BEACH, S.C.

## LOG of BORING

Project: Fort Sumter Tour Boat Facility, Cooper River, Charleston, SC

Boring No. B-5 S. C. I. Project No. 8937 Date 3-6-89

Ground Surface Elev. Assumed 0'0" Datum Gr. Water Elev. 3'2"  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
1	0'0"	1'6"	0'0"		Medium brown fine sand with creosote	3-5-6
				2'0"	wood & root content. (SM W/Root & Wood)*	
2	2'6"	4'0"	2'0"		Loose gray fine sand with creosote	2-3-3
					wood content. (SM W/Wood)*	
3	5'0"	6'6"			Loose gray fine sand with creosote	2-3-5
				7'0"	wood content. (SM W/Wood)*	
4	7'6"	9'0"	7'0"		Medium gray fine sand. (SM)*	2-5-6
5	10'0"	11'6"		12'0"	Medium gray fine sand. (SM)*	3-5-4
6	12'6"	14'0"	12'0"		Loose gray fine sand. (SM)*	2-2-3
7	15'0"	16'6"		17'0"	Loose gray fine sand. (SM)*	2-3-5
8	17'6"	19'0"	17'0"	19'6"	Medium gray fine sand. (SM)*	5-5-7
9	20'0"	21'6"	19'6"		Medium gray organic clay with slight	3-3-2
					creosote wood content. (OL W/Wood)*	
10	25'0"	26'6"	24'0"		Very soft inorganic clay with slight	1-2-2
				29'0"	sand content. (OL)*	
11	30'0"	31'6"	29'0"		Loose gray fine sand with slight shell	1-2-3
				34'6"	content. (SM)*	
12	35'0"	36'6"	34'0"		Medium gray fine sand. (SM)*	8-7-10
13	40'0"	41'6"			Medium gray fine sand with slight	4-6-6
				44'0"	shell content. (SM)*	
14	45'0"	46'6"	44'0"		Loose gray fine sand with slight in-	3-4-6
				49'0"	organic clay & shell content. (SM)*	
15	50'0"	51'6"	49'0"		Medium gray inorganic clay with slight	2-3-5
				54'0"	sand & shell content. (CL)*	
16	55'0"	56'6"	54'0"		Stiff gray inorganic clay with slight	3-4-5
					sand & shell content. (CL)*	

Testing and Sampling in accordance with ASTM D. 1586-67 (1974) continued

Remarks: \*VISUAL UNIFIED SOIL CLASSIFICATION

\*\*LOCALLY CALLED MARL.

USED HOLLOW STEM FLIGHT AUGER TO 5'0" DEPTH AS CASING.



CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: Fort Sumter Tour Boat Facility, Cooper River, Charleston, SC

Boring No. B-5 (Cont.) S. C. I. Project No. 8937 Date 3-6-89

Boring No. \_\_\_\_\_

Ground Surface Elev. Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. 3'2"  
(Minimum of 24 hrs. after completion)

[illegible]

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \*VISUAL UNIFIED SOIL CLASSIFICATION

\*\*LOCALLY CALLED MARL.

USED HOLLOW STEM FLIGHT AUGER TO 5'0" DEPTH AS CASING.



MYRTLE BEACH, SC

SAVANNAH, GA

Project: Fort Sumter Tour Boat Facility, Cooper River, Charleston, S.C.

Project: \_\_\_\_\_  
Boring No. P-1 S. C. I. Project No. 8937 Date 4/7/89

Boring No. \_\_\_\_\_ Assumed 0'0"

Ground Surface Elev. \_\_\_\_\_

Ground Surface Elev. \_\_\_\_\_ Assumed 0.0' Datum \_\_\_\_\_ Gr. Water Elev. \_\_\_\_\_  
(Minimum of 24 hrs. after completion)

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \*Visual Unified Soil Classification



SAVANNAH, GA

Fort Sumter Tour Boat Facility, Cooper River, Charleston, S.C.

Project: \_\_\_\_\_  
 Boring No. P-2 S. C. I. Project No. 8937 Date 4/7/89  
 Ground Surface Elev. \_\_\_\_\_ Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. \_\_\_\_\_  
 (Minimum of 24 hrs. after completion)

[illegible]

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \*Visual Unified Soil Classification











## SAVANNAH GA

Remarks: \_\_\_\_\_



SAVANNAH, GA.

LOG of BORING

Ground Surface Elev. \_\_\_\_\_ Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. \_\_\_\_\_  
(Minimum of 24 hrs. after completion)

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \_\_\_\_\_



## SAVANNAH, GA.

MYRTLE BEACH S.C

## LOG of BORING

Fort Sumter Tour Boat Facility, Cooper River, Charleston, S.C.

Project: \_\_\_\_\_

Boring No. P-6 S. C. I. Project No. 8937 Date 4/5/89

Ground Surface Elev. \_\_\_\_\_ Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. \_\_\_\_\_  
 (Minimum of 24 hrs. after completion)

[illegible]

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \*Visual Unified Soil Classification





## SAVANNAH, GA.

LOG of BORING

Project: \_\_\_\_\_ 1/17/80

Ground Surface Elev. Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. \_\_\_\_\_  
(Minimum of 24 hrs. after completion)

Testing and Sampling in accordance with ASTM D. 1586-67 (1974);

\*Visual Unified Soil Classification.

Remarks: \_\_\_\_\_



SAVANNAH GA

Fort Sumter Tour Boat Facility, Cooper River, Charleston, S.C.

[illegible]

arks: \_\_\_\_\_



SAVANNAH, GA

## LOG of BORING

Fort Sumter Tour Boat Facility, Cooper River, Charleston, S.C.

Subject: \_\_\_\_\_

ring No. P-9 S. C. I. Project No. 8937 Date 4/7/89

ound Surface Elev. \_\_\_\_\_ Assumed 0'0" Datum \_\_\_\_\_ Gr. Water Elev. \_\_\_\_\_  
(Minimum of 24 hrs. after completion)

[illegible]

id Sampling in accordance with ASTM D. 1586-67 (1974)

marks: \*Visual Unified Soil Classification





# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SOUTH CAROLINA

Boring No. 1 S. C. I. Project No. 90108 Date 4/24 & 25/90

Ground Surface Elev. 5.5 \*\*\* Datum M.S.L. Gr. Water Elev. 1.25  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
1	5.5	4.0	5.5		MEDIUM DARK BROWN FINE SAND WITH ROOT	2-9-12
				4.0	CONTENT. (SM W/ROOTS)*	
2	3.0	1.5	4.0	1.0	LOOSE TAN FINE SAND WITH OIL ODOR. (SM)*	2-3-5
3	0.5	-1.0	1.0		VERY LOOSE TAN FINE SAND WITH OIL	2/18"
					ODOR. (SM)*	
4	-2.0	-3.5			VERY LOOSE TAN FINE SAND WITH OIL	1-2-1
					ODOR. (SM)*	
5	-4.5	-6.0			VERY LOOSE TAN FINE SAND WITH OIL	1-1-1
				-6.5	ODOR. (SM)*	
6	-7.0	-8.5	-6.5	-9.0	VERY LOOSE GRAY FINE SAND. (SM)*	1-2-2
7	-9.5	-11.0	-9.0	-11.5	MEDIUM TAN FINE SAND. (SM)*	2-4-7
8	-12.0	-13.5	-11.5		LOOSE TAN FINE SAND. (SM)*	2-3-4
9	-14.5	-16.0		-19.0	LOOSE TAN AND GRAY FINE SAND. (SM)*	2-3-3
10	-19.5	-21.0	-19.0	→	VERY SOFT GRAY ORGANIC CLAY WITH	2/18"
				-24.0	SLIGHT SHELL AND SAND CONTENT. (OL)*	
11	-24.5	-26.0	-24.0		MEDIUM GRAY FINE SAND. (SM)*	5-4-7
12	-29.5	-31.0		-34.0	MEDIUM GRAY FINE SAND. (SM)*	4-8-9
13	-34.5	-36.0	-34.0	-39.0	LOOSE GRAY FINE SAND. (SM)*	3-3-6
14	-39.5	-41.0	-39.0	-44.0	VERY LOOSE GRAY FINE SAND. (SM)*	1-2-1
15	-44.5	-46.0	-44.0		LOOSE GRAY FINE SAND WITH SLIGHT	1-2-4
				-49.0	INORGANIC CLAY AND SHELL CONTENT. (SM)*	
16	-49.5	-51.0	-49.0		VERY LOOSE GRAY FINE SAND WITH HIGH	2-1-2
				-54.0	SHELL CONTENT. (SM W/SHELL)*	
17	-54.5	-56.0	-54.0		LOOSE GRAY FINE SAND WITH HIGH	1-2-3
				-59.0	INORGANIC CLAY CONTENT. (SC)*	
					CONTINUED	

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \*VISUAL UNIFIED SOIL CLASSIFICATION

\*\*LOCALLY CALLED MARL

SHOVEL SAMPLE TAKEN ADJACENT TO BORING INDICATED VARYING

ROOT CONTENT TO A DEPTH OF APPROXIMATELY 9".

\*\*\*GROUND SURFACE ELEVATION ESTIMATED FROM DAVIS AND FLOYD, INC. DRAWING ENTITLED

TOPOGRAPHIC SURVEY FOR AQUARIUM SITE, DATED FEBRAURY 13, 1990.



# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SOUTH CAROLINA

Boring No. 1 (CONT) S. C. I. Project No. 90108 Date 4/24 & 25/90

Ground Surface Elev. 5.5 Datum M.S.L. Gr. Water Elev. 1.25  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
18	-59.5	-61.0	-59.0		STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	4-7-7
19	-64.5	-66.0			STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	5-6-9
20	-69.5	-71.0			STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	4-4-8
21	-74.5	-76.0	-72.5		SHELL AND SAND CONTENT. (CH)*	5-7-8
22	-79.5	-81.0	-79.0		STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	3-11-13
23	-84.5	-86.0	-89.0		VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	5-12-14
24	-89.5	-91.0	-89.0		STIFF BROWNISH GREEN CLACAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-6-7
25	-94.5	-96.0			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-5-8
26	-99.5	-101.0			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-5-10
27	-104.5	-106.0			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	3-6-6
28	-109.5	-111.0	-114.0		STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-4-7
29	-114.5	-116.0	-114.0		VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-5-11

\* Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \_\_\_\_\_



# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SC

Boring No. 2 S. C. I. Project No. 90108 Date 5-8-90

Ground Surface Elev. 2.0 \*\*\* Datum M.S.L. Gr. Water Elev. TIDAL  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
			2.0	-3.0	STONE, METAL, WOOD, GLASS, GRAVEL, ETC. (DEBRIS)	
1	-3.0	-4.5	-3.0		VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT BRICK FRAGMENT, GRAVEL, GLASS, AND WOOD CONTENT. (OL W/DEBRIS)*	1/18"
2	-8.0	-9.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT BRICK FRAGMENT, GRAVEL AND WOOD CONTENT. (OL W/DEBRIS)*	1/18"
3	-13.0	-14.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT BRICK FRAGMENT AND GRAVEL CONTENT. (OL W/DEBRIS)*	1/18"
4	-18.0	-19.5		-21.5	VERY SOFT GRAY ORGANIC CLAY WITH BRICK FRAGMENT, SAND AND WOOD CONTENT. (OL W/DEBRIS)*	1/18"
5	-23.0	-24.5	-21.5		VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	1/18"
6	-28.0	-29.5		-31.0	VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	1/18"
7	-33.0	-34.5	-31.0		VERY SOFT GRAY ORGANIC CLAY WITH HIGH SAND AND SLIGHT SHELL CONTENT. (OL)*	2/18"
8	-38.0	-39.5		-42.5	VERY SOFT GRAY ORGANIC CLAY WITH HIGH SAND AND SLIGHT SHELL CONTENT. (OL)*	2/18"
9	-43.0	-44.5	-42.5	-47.5	SOFT GRAY ORGANIC CLAY WITH SLIGHT SHELL CONTENT. (OL)*	2-1-2
					CONTINUED	

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

emarks: \*VISUAL UNIFIED SOIL CLASSIFICATION

\*\*LOCALLY CALLED MARL

\*\*\* GROUND SURFACE ELEVATION ESTIMATED FROM DAVIS AND FLOYD, INC. DRAWING ENTITLED  
TOPOGRAPHIC SURVEY FOR AQUARIUM SITE, DATED FEBRUARY 13, 1990





CHARLESTON, S.C.

MYRTLE BEACH, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SC

Boring No. 2 (CONT) S. C. I. Project No. 90108 Date 5-8-90

Ground Surface Elev. 2.0 Datum M. S. L. Gr. Water Elev. TIDAL  
(Minimum of 24 hrs. after completion)

[illegible]

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \_\_\_\_\_





# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

MYRTLE BEACH, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SC

Boring No. 3 S. C. I. Project No. 90108 Date 4-27 & 30-90 5-07-90

Ground Surface Elev. 4.0 \*\*\* Datum M.S.L. Gr. Water Elev. 2.17  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
1	4.0	2.5	4.0		MEDIUM TAN FINE SAND WITH HIGH BRICK	4-8-9
					FRAGMENT, SHELL, WOOD, METAL, GLASS	
					AND ROOT CONTENT. (SM W/DEBRIS)*	
2	1.5	0.0			MEDIUM DARK TAN FINE SAND WITH HIGH	5-7-10
					BRICK FRAGMENT, WOOD, METAL AND GLASS	
					CONTENT. (SM W/DEBRIS)*	
3	-1.0	-2.5			MEDIUM DARK TAN FINE SAND WITH HIGH	4-4-8
					BRICK FRAGMENT, WOOD, METAL, AND GLASS	
					CONTENT. (SM W/DEBRIS)*	
4	-3.5	-4.0			MEDIUM DARK TAN FINE SAND WITH HIGH	3-6-12
					BRICK FRAGMENT, WOOD, GRAVEL AND	
					METAL CONTENT. (SM W/DEBRIS)*	
5	-6.0	-7.5			MEDIUM DARK TAN FINE SAND WITH HIGH	8-11-15
					BRICK FRAGMENT, WOOD, GRAVEL AND	
				-8.0	METAL CONTENT. (SM W/DEBRIS)*	
6	-8.5	-10.0	-8.0		VERY SOFT GRAY ORGANIC CLAY WITH	1/18"
					SAND AND OIL ODOR. (OL)*	
7	-11.0	-12.5			VERY SOFT GRAY ORGANIC CLAY WITH	1/18"
					SLIGHT SAND AND OIL ODOR. (OL)*	
8	-13.5	-15.0			VERY SOFT GRAY ORGANIC CLAY WITH	1/18"
				-15.5	SLIGHT SAND AND OIL ODOR. (OL)*	
9	-16.0	-16.67	-15.5		VERY SOFT GRAY ORGANIC CLAY WITH	1/2" 54/2"
				-17.0	WOOD CONTENT. (OL W/WOOD)*	
10	-21.0	-22.5	-17.0		VERY SOFT GRAY ORGANIC CLAY WITH	1/18"
					SLIGHT SAND CONTENT. (OL)*	
					CONTINUED	

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \*VISUAL UNIFIED SOIL CLASSIFICATION

\*\*LOCALLY CALLED MARL

DRILL RIG MOVED 15 TIMES TO ADVANCE DRILL HOLE.

\*\*\* GROUND SURFACE ELEVATION ESTIMATED FROM DAVIS & FLOYD, INC. DRAWING ENTITLED  
TOPOGRAPHIC SURVEY FOR AQUARIUM SITE, DATED FEBRUARY 13, 1990.



# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SC

Boring No. 3 (CONT) S. C. I. Project No. 90108 Date 4-27 & 30-90 5-07-90

Ground Surface Elev. 4.0 Datum M.S.L. Gr. Water Elev. 2.17

(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
11	-26.0	-27.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND CONTENT. (OL)*	1/18"
12	-31.0	-32.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND CONTENT. (OL)*	1/18"
13	-36.0	-37.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND CONTENT. (OL)*	1/18"
14	-41.0	-42.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND CONTENT. (OL)*	1/18"
				-45.0	SLIGHT SAND CONTENT. (OL)*	
15	-46.0	-47.5	-45.0		MEDIUM GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	2-2-3
16	-51.0	-52.5			MEDIUM GRAY INORGANIC CLAY WITH MEDIUM SAND CONTENT. (CH)*	2-3-3
				-55.0	SAND CONTENT. (CH)*	
17	-56.0	-57.5	-55.0		LOOSE GRAY FINE SAND WITH MEDIUM INORGANIC CLAY CONTENT. (SC)*	2-3-2
18	-61.0	-62.5			LOOSE GRAY FINE SAND WITH INORGANIC CLAY CONTENT. (SC)*	3-3-3
				-65.0	CLAY CONTENT. (SC)*	
19	-66.0	-67.5	-65.0		VERY SOFT GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	1-1-1
				-70.0	SLIGHT SAND CONTENT. (CH)*	
20	-71.0	-72.5	-70.0		SOFT GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	1-1-2
				-75.0	SAND CONTENT. (CH)*	
21	-76.0	-77.5	-75.0		STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	5-8-8

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \_\_\_\_\_



# SOIL CONSULTANTS, INC.

## CHARLESTON, S.C.

SAVANNAH, GA.

MYRTLE BEACH, S.C.

### LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SOUTH CAROLINA

Boring No. 4 S. C. I. Project No. 90108 Date 4/24 & 25/90

Ground Surface Elev. 6.0 \*\*\* Datum M.S.L. Gr. Water Elev. 2.0  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
1	6.0	4.5	6.0		MEDIUM BROWN FINE SAND WITH SLIGHT	3-15-10
					BRICK, CONCRETE FRAGMENT AND ROOT	
				4.0	CONTENT. (SM W/ROOTS AND DEBRIS)*	
2	3.5	2.0	4.0		MEDIUM BROWN FINE TO COARSE SAND WITH	5-6-7
				1.5	OIL ODOR. (SM-SP)*	
3	1.0	-0.5	1.5		LOOSE GRAY FINE TO COARSE SAND WITH	3-4-4
				-1.0	OIL ODOR. (SM-SP)*	
4	-1.5	-3.0	-1.0		LOOSE GRAY FINE SAND WITH OIL ODOR. (SM)*	3-3-2
5	-4.0	-5.5			LOOSE GRAY FINE SAND WITH OIL ODOR. (SM)*	2-3-3
6	-6.5	-8.0		-8.5	LOOSE TAN FINE SAND. (SM)*	2-2-3
7	-9.0	-10.5	-8.5	→	VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT	1-1-1
					SAND AND OIL ODOR. (OL)*	
8	-11.5	-13.0			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT	1-1-1
				-13.5	SAND AND OIL ODOR. (OL)*	
9	-14.0	-15.5	-13.5		VERY STIFF GRAY INORGANIC CLAY WITH	8-10-16
					DECAYED WOOD AND SLIGHT SAND	
				-18.5	CONTENT. (CL)*	
10	-19.0	-20.5	-18.5		VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT	1-1-1
					SAND AND DECAYED WOOD CONTENT. (OL)*	
11	-24.0	-25.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT	1-1-1
					SAND AND DECAYED WOOD CONTENT. (OL)*	
12	-29.0	-30.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT	1/18"
					SAND CONTENT. (OL)	
13	-34.0	-35.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT	1/18"
					SAND CONTENT. (OL)*	
					CONTINUED	

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \*VISUAL UNIFIED SOIL CLASSIFICATION

\*\*LOCALLY CALLED MARL

SHOVEL SAMPLE TAKEN ADJACENT TO BORING INDICATED VARYING

ROOT CONTENT TO A DEPTH OF APPROXIMATELY 6".

\*\*\* GROUND SURFACE ELEVATION ESTIMATED FROM DAVIS AND FLOYD, INC. DRAWING ENTITLED

TOPOGRAPHIC SURVEY FOR AQUARIUM SITE, DATED FEBRUARY 13, 1990.





## SAVANNAH, GA.

MYRTLE BEACH, S.C.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SOUTH CAROLINA

Boring No. 4 (CONT) S. C. I. Project No. 90108 Date 4/24 & 25/90

Ground Surface Elev. 6.0 Datum M. S. L. Gr. Water Elev. 2.0  
(Minimum of 24 hrs. after completion)

[illegible]

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

marks: \_\_\_\_\_



# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SC

Boring No. 5 S. C. I. Project No. 90108 Date 5-3-90

Ground Surface Elev. -2.0 \*\*\* Datum M.S.L. Gr. Water Elev. TIDAL  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
					TIME BORING STARTED 0900	
			-1.0	-2.0	WATER	
1	-2.0	-3.5	-2.0		VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	1/18"
2	-6.0	-7.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	1/18"
3	-11.0	-12.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	1/18"
4	-16.0	-17.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	1/18"
5	-21.0	-22.5		-25.0	VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	2/18"
6	-26.0	-27.5	-25.0	-30.0	VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND, <u>HIGH WOOD</u> AND OIL ODOR. (OL)*	1-1-1
7	-31.0	-32.5	-30.0		VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND SHELL CONTENT. (OL)*	1-1-1
8	-36.0	-37.5		-39.5	VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND SHELL CONTENT. (OL)*	2/18"
9	-41.0	-42.5	-39.5	-45.0	SOFT GRAY INORGANIC CLAY WITH SLIGHT SAND AND SHELL CONTENT. (CH)*	2-2-2
10	-46.0	-47.5	-45.0	-50.0	MEDIUM GRAY INORGANIC CLAY WITH SLIGHT SAND AND SHELL CONTENT. (CH)*	2-2-3
11	-51.0	-52.5	-50.0		STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND AND SHELL CONTENT. (CH)*	2-3-6
12	-56.0	-57.5			STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND AND SHELL CONTENT. (CH)*	2-4-6
					(CONTINUED)	

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \*VISUAL UNIFIED SOIL CLASSIFICATION

\*\*LOCALLY CALLED MARL

SURFACE DEBRIS WAS EVIDENT IN THE VICINITY OF THIS BORING LOCATION

\*\*\* GROUND SURFACE ELEVATION ESTIMATED FROM DAVIS AND FLOYD, INC. DRAWING

ENTITLED TOPOGRAPHIC SURVEY FOR AQUARIUM SITE, DATED FEBRUARY 13, 1990.



SAVANNAH, GA.

LOG of BORING

Remarks: \_\_\_\_\_





# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SOUTH CAROLINA

Boring No. 6 S. C. I. Project No. 09108 Date 4/26/ & 4/27/90

Ground Surface Elev. -7.0 \*\*\* Datum M. S. L. Gr. Water Elev. TIDAL  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
					TIME BORING STARTED 1053	
			0.0	-7.0	WATER	
1	-7.0	-8.5	-7.0		VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND CONTENT. (OL)*	1/18"
2	-12.0	-13.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND CONTENT. (OL)*	1/18"
3	-17.0	-18.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND CONTENT. (OL)*	1/18"
4	-22.0	-23.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND CONTENT. (OL)*	1-1-1
5	-27.0	-28.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND CONTENT. (OL)*	1/18"
6	-32.0	-33.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND CONTENT. (OL)*	1/18"
7	-37.0	-38.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND SHELL CONTENT. (OL)*	1/18"
8	-42.0	-43.5		-45.5	VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND SHELL CONTENT. (OL)*	1/18"
9	-47.0	-48.5	-45.5		SOFT GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	2-2-2
10	-52.0	-53.5		-56.0	SOFT GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	2-2-2
11	-57.0	-58.5	-56.0		VERY STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND AND SHELL CONTENT. (CH)*	3-8-8
12	-62.0	-63.5		-66.0	VERY STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	5-8-9
					(CONTINUED)	

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \*VISUAL UNIFIED SOIL CLASSIFICATION

\*\*LOCALLY CALLED MARL

\*\*\* GROUND SURFACE ELEVATION ESTIMATED FROM DAVIS AND FLOYD, INC. DRAWING ENTITLED TOPOGRAPHIC SURVEY FOR AQUARIUM SITE, DATED FEBRUARY 13, 1990.





# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SOUTH CAROLINA

Boring No. 6 (CONT) S. C. I. Project No. 90108 Date 4/26 & 27/90

Ground Surface Elev. -7.0 \*\*\* Datum M.S.L. Gr. Water Elev. TIDAL  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
13	-67.0	-68.5	-66.0		STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	4-6-8
14	-72.0	-73.5			STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	4-5-5
15	-77.0	-78.5	-74.5		VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	5-9-14
16	-82.0	-83.5			VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-7-11
17	-87.0	-88.5	-85.0		STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	5-6-9
18	-92.0	-93.5			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-7-7
19	-97.0	-98.5			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-4-6
20	-102.0	-103.5			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	5-6-8
21	-107.0	-108.5			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-5-10
22	-112.0	-113.5			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	3-4-8
23	-117.0	-118.5			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	5-5-7

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

marks: \_\_\_\_\_

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# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SOUTH CAROLINA

Boring No. 7 S. C. I. Project No. 90108 Date 5/1 & 2/90

Ground Surface Elev. -8.0 \*\*\* Datum M.S.L. Gr. Water Elev. TIDAL  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
					TIME BORING STARTED 1000	
			-4.0	-8.0	WATER	
1	-8.0	-9.5	-8.0		VERY SOFT GRAY ORGANIC CLAY WITH	1/18"
				-12.0	SLIGHT SAND CONTENT. (OL)*	
2	-16.0	-17.5	-12.0		VERY SOFT GRAY ORGANIC CLAY WITH	1/18"
					SLIGHT SAND AND OIL ODOR. (OL)*	
3	-21.0	-22.5			VERY SOFT GRAY ORGANIC CLAY WITH	1/18"
				-24.5	SLIGHT SAND AND OIL ODOR. (OL)*	
4	-26.0	-27.5	-24.5		VERY SOFT GRAY ORGANIC CLAY WITH	1/18"
					SLIGHT SAND CONTENT. (OL)*	
5	-31.0	-32.5			VERY SOFT GRAY ORGANIC CLAY WITH	1/18"
					SLIGHT SAND AND SHELL CONTENT. (OL)*	
6	-36.0	-37.5			VERY SOFT GRAY ORGANIC CLAY WITH	1-1-1
					SLIGHT SAND AND SHELL CONTENT. (OL)*	
7	-41.0	-42.5			VERY SOFT GRAY ORGANIC CLAY WITH	1-1-1
				-44.5	SLIGHT SAND AND SHELL CONTENT. (OL)*	
8	-46.0	-47.5	-44.5		SOFT GRAY ORGANIC CLAY WITH SLIGHT	2-2-2
				-50.0	SAND AND SHELL CONTENT. (OL)*	
9	-51.0	-52.5	-50.0	?	VERY LOOSE GRAY FINE SAND WITH SLIGHT	2/18"
				-55.0	ORGANIC CLAY AND SHELL CONTENT. (SM)*	
10	-56.0	-57.5	-55.0		LOOSE FINE SAND WITH SLIGHT SHELL	5-5-5
				-60.0	CONTENT. (SM)*	
11	-61.0	-62.5	-60.0		STIFF GRAY INORGANIC CLAY WITH SLIGHT	3-4-5
					SAND AND SHELL CONTENT. (CH)*	
12	-66.0	-67.5			STIFF GRAY INORGANIC CLAY WITH SLIGHT	4-5-6
					SAND AND SHELL CONTENT. (CL)*	(CONTINUED)

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \*VISUAL UNIFIED SOIL CLASSIFICATION

\*\*LOCALLY CALLED MARL

\*\*\* GROUND SURFACE ELEVATION ESTIMATED FROM DAVIS AND FLOYD, INC. DRAWING ENTITLED TOPOGRAPHIC SURVEY FOR AQUARIUM SITE, DATED FEBRUARY 13, 1990.



# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SOUTH CAROLINA

Boring No. 7 (CONT) S. C. I. Project No. 90108 Date 5/1 & 2/90

Ground Surface Elev. -8.0\*\*\* Datum M.S.L. Gr. Water Elev. TIDAL  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
13	-71.0	-72.5			STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND AND SHELL CONTENT. (CL)*	4-6-7
14	-76.0	-77.5			STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND AND SHELL CONTENT. (CL)*	3-4-5
				-79.5		
15	-81.0	-82.5	-79.5		VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	6-12-15
16	-86.0	-87.5			VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	5-8-10
17	-91.0	-92.5			VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-8-12
18	-96.0	-97.5			VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	5-5-14
19	-101.0	-102.5			VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-6-12
20	-106.0	-107.5			VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	3-5-11
				-109.5		
21	-111.0	-112.5	-109.5		STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	5-5-10
				-115.0		
22	-116.0	-117.5	-115.0		VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	4-5-11
				-119.5		
23	-121.0	-122.5	-119.5		STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT.** (MH)*	6-7-8

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks: \_\_\_\_\_





# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SOUTH CAROLINA

Boring No. 8 S. C. I. Project No. 90108 Date 5/9 & 10/90

Ground Surface Elev. 2.0 \*\*\* Datum M.S.L. Gr. Water Elev. TIDAL  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
			2.0	-3.0	STEEL, RIP-RAP, CABLE, DEBRIS, ETC.	
1	-3.0	-4.5	-3.0		VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	1/18"
2	-8.0	-9.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	1/18"
3	-13.0	-14.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	1/18"
4	-18.0	-19.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	1/18"
5	-23.0	-24.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	2/18"
6	-28.0	-29.5			VERY SOFT GRAY ORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	2/18"
7	-33.0	-34.5	-32.5		MEDIUM GRAY INORGANIC CLAY WITH SLIGHT SAND AND OIL ODOR. (OL)*	4-4-4
				-37.5	HIGH SAND AND SLIGHT SHELL CONTENT. (CL)*	
8	-38.0	-39.5	-37.5		MEDIUM GRAY FINE SAND WITH SLIGHT SHELL CONTENT. (SM)*	3-6-5
9	-43.0	-44.5	-42.5		VERY STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND AND SLIGHT SHELL CONTENT. (CL)*	3-8-8
10	-48.0	-49.5	-47.5		STIFF GRAY ORGANIC CLAY WITH MEDIUM SAND AND SLIGHT PHOSPHATIC NODULES AND DECAYED WOOD CONTENT. (OL)*	3-4-5
					CONTINUED	

Logging and Sampling in accordance with ASTM D. 1586-67 (1974)

\*VISUAL UNIFIED SOIL CLASSIFICATION

Remarks: \*\*LOCALLY CALLED MARL.

THE TOP 5' OF THE SOIL PROFILE CONTAINED HEAVY DEBRIS.

\*\*\* GROUND SURFACE ELEVATION ESTIMATED FROM DAVIS AND FLOYD, INC. DRAWING ENTITLED TOPOGRAPHIC SURVEY FOR AQUARIUM SITE, DATED FEBRUARY 13, 1990.



# SOIL CONSULTANTS, INC.

CHARLESTON, S.C.

MYRTLE BEACH, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SOUTH CAROLINA

Boring No. 8 (CONT.) S. C. I. Project No. 90108 Date 5/9 & 10/90

Ground Surface Elev. 2.0 Datum M.S.L. Gr. Water Elev. TIDAL  
(Minimum of 24 hrs. after completion)

Sample No.	SAMPLE Elev. - Feet & Inches		STRATUM Elev. - Feet & Inches		VISUAL FIELD CLASSIFICATION	Blows Per 6 Inches
	From	To	From	To		
11	-53.0	-54.5			STIFF GRAY ORGANIC CLAY WITH MEDIUM SAND AND SHELL, MEDIUM PHOSPHATIC NODULES AND DECAYED WOOD CONTENT. (OL)*	3-5-6
12	-58.0	-59.5			STIFF GRAY ORGANIC CLAY WITH SLIGHT SAND AND SHELL, SLIGHT PHOSPHATIC NODULES AND DECAYED WOOD CONTENT. (OL)*	4-4-6
				-60.0		
13	-63.0	-64.5	-60.0		STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	3-6-6
14	-68.0	-69.5			STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	3-8-6
15	-73.0	-74.5			STIFF GRAY INORGANIC CLAY WITH SLIGHT SAND CONTENT. (CH)*	4-7-7
				-77.5		
16	-78.0	-79.5	-77.5		VERY STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT. **(MH)*	3-8-11
				-82.5		
17	-83.0	-84.5	-82.5		STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT. **(MH)*	4-6-8
18	-88.0	-89.5			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT. **(MH)*	3-7-8
19	-93.0	-94.5			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT. **(MH)*	4-6-7
20	-98.0	-99.5			STIFF BROWNISH GREEN CALCAREOUS CLAY WITH SLIGHT SAND CONTENT. **(MH)*	5-6-9
					CONTINUED	

Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

Remarks:



CHARLESTON, S.C.

MYRTLE BEACH, S.C.

SAVANNAH, GA.

## LOG of BORING

Project: PROPOSED AQUARIUM, CHARLESTON, SOUTH CAROLINA

Boring No. 8 (CONT.) S. C. I. Project No. 90108 Date 5/9 & 10/90

Ground Surface Elev. 2.0 Datum M.S.L. Gr. Water Elev. TIDAL  
(Minimum of 24 hrs. after completion)

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Testing and Sampling in accordance with ASTM D. 1586-67 (1974)

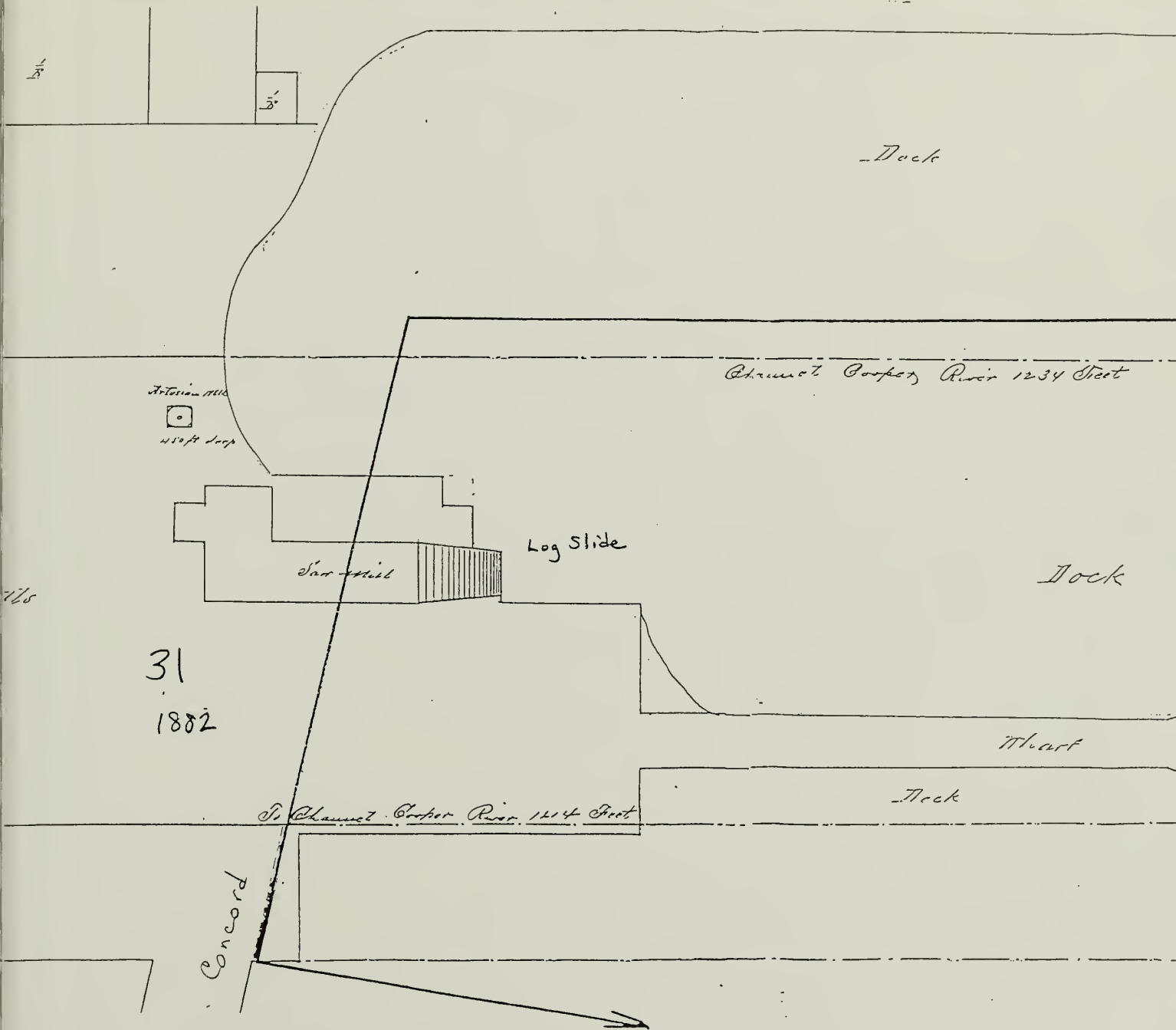
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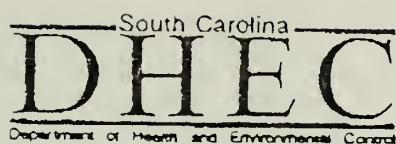












## MEMORANDUM

TO: File

FROM: Judy Canova, Hydrologist *JC*  
Superfund and Solid Waste Section  
Division of Hydrogeology  
Bureau of Solid and Hazardous Waste Management

DATE: August 24, 1992

RE: National Park Service, Charleston Harbor Site  
Site Visit  
SCD 987 572 674  
Charleston County

On August 17 and 18, 1992, the referenced facility was visited in order to observe well installation by General Engineering Laboratories (GEL) and to split soil samples. Upon arrival at the site on August 17 at 8:15 am, the rig was in operation on the George Campsen property at one of the additional locations specified during the August 10 meeting with the National Park Service and the USEPA. A soil sample had already been taken from the 3 to 5 foot depth interval. At a depth of approximately eleven feet, the rig encountered an impenetrable object. After several unsuccessful attempts at penetration, the rig was moved to a nearby location.

While observing the well drilling, I noted that the auger was not decontaminated between locations on the Campsen property and that unused augers were not covered and were stored on bare ground. At the second, third, and fourth locations on the Campsen property, impenetrable material was encountered between depths of eight and twelve feet. The fifth location also encountered material that was difficult to penetrate at approximately twelve feet, but the rig managed to penetrate after an extended period of time. At an approximate depth of fourteen feet, where it was expected that the underlying clayey material would be encountered, two 2-foot split spoon samples were taken. No clay was observed. I left the site to make a phone call. Upon returning to the site, the well was being installed. For an unknown reason, the auger flights had been removed and clay had been observed at approximately fourteen feet below ground surface on one of the auger flights. The auger was then reinserted to install the well, and this was reported to me when I returned. A split spoon sample of the "clay" was obtained





and observed. It appeared to contain more clay than sand, but a significant portion of fine sand and silt was also observed. A soil sample was collected from this interval. An attempt was made to collect a soil sample from the 4 to 5 foot interval in this location using a hand auger, but penetration to this depth was not achieved. After the well was installed, the rig and augers were decontaminated, and I left the site.

While the rig was being moved, I inspected the aquarium site and the outfall from the drainage easement as it emptied into the Cooper River. A silver sheen was present on the water near the outfall. While inspecting the aquarium site, I noticed that several soil borings, which had been previously installed to characterize the suitability of the site for construction, had not been grouted. Water with a silver sheen was observed in several of the holes. The sheen did not break apart when a stone was dropped into the hole, suggesting that the sheen was not the result of iron bacteria.

On August 18, I arrived on site at 6:30 am. The rig had been moved to the northern proposed well location on the aquarium site. The DHEC split of soil samples from this location was designated as coming from MW-11, although the actual well number was unknown. The well was drilled to encounter the bottom of a suspected "trough" in the clay with the expectation that, if DNAPL was present, it might pool in the trough. At 7:00 am, an initial soil sample was collected from the ground surface and was split with SCDHEC; it was a medium grey clayey sand. A second split sample was obtained from 3-5 feet below ground surface at 7:10 am. It was composed of light green to medium grey sand. The third sample from this location was collected from 19-23 feet below ground surface at 8:10 am. Part of this sample included a medium grey sandy clay which was mixed with the remainder of the sampled interval which was mostly a medium to dark grey clayey sand. A faint creosote type odor was noticed. The sandy clay in this interval occurred at approximately 22.5 to 23 feet below ground surface. The method used to mix the sand and clay included using gloved hands to manually mix the soil. Another split spoon sample was taken from 23-25 feet and had no recovery; this was interpreted as a sand. A split spoon from 26-28 feet recovered sandy clay, and a composite sample from 26-30 feet, taken by General Engineering, was split with SCDHEC at 9:55 am. Samples from this well location were labelled as coming from MW-11. A review of nearby soil borings indicated that the clay in the vicinity of this well is not continuous or thick. The "clay" itself appears to be a silty sandy clay that may have a relatively high permeability. Its ability to perform as an aquitard appears to be quite limited, and the lack of a continuous clay at this depth interval in the vicinity of the aquarium site should be considered in the site scoring process.

A well was initially installed in this location, but due to collapse of material in the hole, the well casing was pulled out along with the auger flights. The auger flights, which were not decontaminated and had been stored on the ground surface, were reinserted in the hole even though I had requested that they be decontaminated prior to reuse. This probably resulted in cross-contamination as the upper aquifer likely contacted contaminants from the clayey areas that had a creosote odor. I left the site briefly and when I returned, I found that an employee for the City of Charleston was steam cleaning the auger flights. GEL then moved the rig a few feet away and installed a well to the same depth as the initial hole on the aquarium site. At this time, I left the site.



In summary, I made the following observations were made during the site visit: 1) there was an overall lack of concern for proper decontamination procedures and for keeping clean equipment protected, 2) the well construction techniques did not include pressure grouting or using tremie pipes to install sand packs, 3) the screen slot/sand pack size did not appear appropriate for the sediments encountered at the site, 4) open boreholes on site had not been properly grouted and groundwater in the boreholes had a visible sheen, 5) soil sample mixing was accomplished using gloved hands, 6) no duplicate samples or equipment blanks were taken, and 7) there was an overall lack of notetaking.

cc: Christine Coker, Trident EQC



## HYDROGEOLOGY

(Name)

(County)  
Charles ton

2. *Alu*

### Sample Description

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Surface Soil

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19-23-5011

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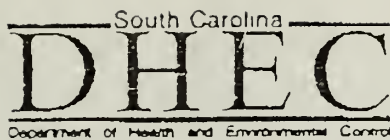
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Lab Number





## MEMORANDUM

TO: File

FROM: Judy Canova, Hydrologist *JC*  
Superfund and Solid Waste Section  
Division of Hydrogeology  
Bureau of Solid and Hazardous Waste Management

DATE: August 28, 1992

RE: National Park Service, Charleston Harbor Site  
Site Visit  
SCD 987 572 674  
Charleston County

On August 26, 1992, the referenced facility was visited in order to observe well installation by General Engineering Laboratories (GEL) and to split soil samples. The final well was being installed at the interior southwestern corner of the proposed aquarium site. Christine Coker had arrived at the site at 6:45 am and had accepted a split sample from the 3-4' interval. When I arrived at the site at approximately 10:15 am, an attempt was being made to collect split spoon samples from the surface of the clay unit. At 10:20, a sample from the 27-31' interval was composited, sampled, and split with SCDHEC. The sample was a dark grey sandy clay with a creosote-odor. Several attempts to obtain samples above this interval had failed, apparently because of the fluid nature of the medium at this depth. All samples from this location were labelled as coming from MW-12.

At approximately 10:45, GEL began removing the auger flights from the hole. As the flights were being removed, a thick black substance began coming out of the hole. It appeared to be free-phase creosote mixed with soil. At approximately twenty feet from the well location, a strong creosote odor was noticed, but no air monitoring equipment was being used to determine ambient air quality in the breathing zone around the rig. To gain a worst case estimate of the concentration of constituents at this well location, a sample was collected from the auger flight that had been used at the 12 to 16 foot interval. At approximately 11:15 am, a sample from this location was placed on aluminum foil and forced into a sample jar using gloved hands as SCDHEC personnel did not have access to more appropriate sampling





equipment. GEL did not express an interest in splitting this sample. The black material continued to come out of the hole until the final auger flight was removed. The two GEL people installing the well came into contact with the black material on their forearms which were not covered by protective clothing at the time. The overall lack of concern by GEL for personal protection and safety was consistently demonstrated.

I briefly walked around the site to observe the nature of the soil cuttings which were left in place around the previously installed wells. Soil cuttings at several well locations appeared to contain product including the three wells along the road and the well at B-1. Cuttings from an additional well that may have encountered product were seen at location W-5. Cuttings at W-4 had a turpentine odor. Two of three boreholes drilled by GEL on the Campsen property, which instead of being properly grouted were left open, had a visible silver sheen on the water surface.

After inspecting the soil cuttings, I returned to observe the well installation activities. The sand pack bridged within the auger, which probably resulted in a collapse of soil around the well screen. A twenty foot screen was installed at the final well location which may result in dilution of the dissolved contamination that is present. None of the wells on site were grouted, apparently because the bentonite seals extended to a few feet below ground surface. Soil had collapsed into the upper annular space of several of the wells on site.

At approximately 12:30 pm after the bentonite had been added to the final well, I left the site.

cc: Christine Coker, Trident EQC



(Name) \_\_\_\_\_  
SCD \_\_\_\_\_  
Samplers (Signature) \_\_\_\_\_

OW - Drinking Water  
MW - Monitoring Well  
WW - Waste Water  
SW - Surface Water  
Station# \_\_\_\_\_  
Date \_\_\_\_\_  
Sample Description \_\_\_\_\_

RC - RCRA  
CW - Chemical Waste  
HW - Hazardous Waste  
SD - Solid Waste  
CP \_\_\_\_\_  
GR \_\_\_\_\_  
Time \_\_\_\_\_  
Date \_\_\_\_\_

Relinquished By (Signature) \_\_\_\_\_  
Date \_\_\_\_\_  
Received By (Signature) \_\_\_\_\_  
Time \_\_\_\_\_  
Received for Lab By (Signature) \_\_\_\_\_  
Date \_\_\_\_\_

Metals - \_\_\_\_\_  
Volatile Organics \_\_\_\_\_  
BNA - Semi Volatile \_\_\_\_\_  
Pesticide/PBS's \_\_\_\_\_  
Herbicide \_\_\_\_\_  
PH - Alkalinity - TS \_\_\_\_\_  
Flash Point \_\_\_\_\_  
Phenols \_\_\_\_\_  
Cyanides \_\_\_\_\_  
COD \_\_\_\_\_  
TOC \_\_\_\_\_  
Nutrients \_\_\_\_\_  
Fluoride \_\_\_\_\_  
Other \_\_\_\_\_  
Lab Number \_\_\_\_\_

Relinquished By (Signature) \_\_\_\_\_  
Date \_\_\_\_\_  
Received By (Signature) \_\_\_\_\_  
Time \_\_\_\_\_  
Remarks \_\_\_\_\_



(Name)

SCO

Samplers (Signature)

DW - Drinking Water  
MW - Monitoring Well  
WW - Waste Water  
SW - Surface Water

RC - RCRA  
CW - Chemical Waste  
HW - Hazardous Waste  
SD - Solid Waste

Station#

Date

Time

CP

GR

Sample Description

11 3 41  
11 31 31

Relinquished By (Signature)

Relinquished By (Signature)

Date

Date

Time

Time

Received By (Signature)

Received For Lab By (Signature)

Received By (Signature)

Relinquished By (Signature)

Time

Remarks

Time

Date

Received By (Signature)

Metals  
Volatiles Organics  
BNA - Semi Volatile  
Pesticide/PBS's  
Herbicide  
PH - Alkalinity - TS  
Flash Point  
Phenols  
Cyanides  
COD  
TOC  
Nutrients  
Fluoride  
Other

Lab Number







UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.  
ATLANTA, GEORGIA 30366

FEB 25 1993  
AND-PFB

Mr. James W. Coleman, Jr.  
Regional Director  
Southeast Region  
National Park Service  
U.S. Department of the Interior  
75 Spring Street, S.W.  
Atlanta, Georgia 30303

Re: Draft Expanded Site Inspection Report (ESI)  
National Park Service Charleston Harbor Site,  
Charleston, South Carolina, November 20, 1992

Dear Mr. Coleman:

The U.S. Environmental Protection Agency (EPA) and the South Carolina Department of Health and Environmental Control (SCDHEC) have jointly reviewed the above referenced document for purposes of the Hazard Ranking System (HRS), pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended. Specifically, the document was reviewed under the HRS for placement of the Charleston Harbor Site (CHS) on the CERCLA National Priorities List (NPL).

EPA has determined that the above referenced Expanded Site Investigation (ESI) report is incomplete and that additional information is needed. The additional information is outlined in the enclosed comments and includes more extensive sampling and analysis than is contained in the draft report.

The comments are arranged in four parts:

- HRS Comments
- General Comments
- Specific Section Comments
- Typographical Errors

In addition to the comments, the EPA guidance document entitled, Guidance for Performing Site Inspections Under CERCLA, Interim Final, September 1992 (copy enclosed), must be used in performing the ESI. It appears that this guidance document was not followed



during development of the above referenced ESI and ESI report. Also, it is noted here that the ESI was performed prior to completion of EPA's comments on the ESI workplan and therefore did not reflect these comments.

Since the National Park Service (NPS) has stated in previous discussions that the ESI will include sampling for site characterization and risk assessment purposes, we have included comments concerning these activities which are beyond minimum requirements for HRS purposes. In addition to these comments, specific CERCLA guidance pertaining to Remedial Investigation Site Characterization and Risk Assessment should also be followed. These guidance documents may be obtained through the Superfund Docket (202/260-9760) and are listed below.

- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA  
EPA/540/G-89/004
- Risk Assessment Guidance for Superfund  
Volume I  
Human Health Evaluation Manual  
(Part A)  
EPA/540/1-89/002
- Ecological Assessment of Hazardous Waste Sites:  
A Field and Laboratory Reference  
EPA/600/3-89/013

Use of these guidance documents should minimize any additional studies and/or remediation which may be necessary should the CHS be placed on the NPL or investigated as an Area of Concern (AOC) in conjunction with the Calhoun Park/Ansonbrough Homes/SCE&G Coal Gas (SCE&G) site next door.

As requested, we have also reviewed General Engineering Laboratory's November 23, 1992, response to SCDHEC's August 28, 1992, memorandum, concerning SCDHEC's observations during the field investigation for the ESI. These comments are also enclosed.

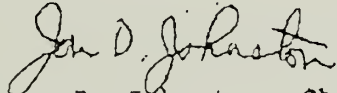
As stated in previous correspondence and meetings, the remedial activities at the CHS (including the current ESI and any future remedial investigation and remedial action) should be coordinated with remedial activities at the SCE&G site next door. A meeting on March 2, 1992, has been scheduled to discuss this coordination as well as to discuss the enclosed comments.



Any remediation and/or construction at CHS may be impacted if CHS is placed on the NPL or is investigated as an LOC in conjunction with the SCE&G site next door. This impact may include additional studies and/or remediation at CHS. Any release of hazardous substances during remediation and/or construction at CHS could also result in liability issues with the SCE&G site and potential CERCLA removal action by EPA or the State.

If there are questions or comments concerning any of the above, please contact Mr. J.C. Meredith, P.E., Senior Remedial Project Manager, at 404/347-3016.

Sincerely,



Jon D. Johnston, Chief  
Federal Facilities Branch  
Waste Management Division

Enclosure

cc: Mr. Lewis Badenbaugh, SCDHEC



EPA and SCDHEC Joint Comments on the Draft Expanded Site  
Inspection Report, National Park Service  
Charleston Harbor Site, November 20, 1992

Section in  
Work Plan

A. Hazard Ranking System (HRS) Comments

1. Guidance for Performing Site Inspections Under CERCLA, Interim Final, EPA, September 1992, must be utilized in the revision of the BSI report in order to present the information in a format easily transferrable to the HRS. Section 1.0
2. Background samples of groundwater and soil must be taken and analyzed for chemicals on the EPA Target Compound List (TCL) and Target Analyte List (TAL). Section 2.0
3. Estimates of the quantity of hazardous materials present must be presented; in particular, contaminated soil. Section 2.0
4. All possible source areas of hazardous substances must be identified. Section 1.2.1  
Line I&J
5. Environmental and human targets must be identified. Even though much of that information is provided in previous studies, such as the Site Screening Investigation, Calhoun Park/Ansonborough Homes/Coal Gas, Charleston County, South Carolina DHEC, June 4, 1992, it should be summarized and discussed in the BSI report. Section 1.2.2
6. A section on surface water should be added after Section IV, focusing on the Cooper River and downstream surface water bodies. Section 1.2.1  
Line G
7. The following information is needed in developing a score under the HRS: average annual rainfall and evaporation; 2-year, 24-hour rainfall; latitude and longitude; flood plain information; agricultural and industrial uses; population counts related to drinking water (based on USGS 7.5' maps and water system information); fishery production in the Cooper River, Cooper River discharge data; and tidal information. Section 1.2.1
8. In the Executive Summary and other sections of the report, Fernoline Chemical Company is referred to as a creosoting facility. While the company may have done some creosoting of lumber, it was probably limited. One of the historical references lists the equipment that was left at the plant at the time it was sold, and the company had only one small creosoting cylinder. Also, the years of operation of Fernoline were between 1884 and 1892, not 1902 as stated on page 3 of the report (see Owner and Operator Paper on the Calhoun Street Park and Ansonborough Homes, 1/15/91). Section 1.2.  
Line J
9. In the Executive Summary, a discussion of the surface water pathway neglects to discuss the nearest fishery and wetlands. Section 1.2.  
Line G





both of which are critical to developing an accurate ERS  
error. Also, the Cooper River is a habitat for the Short-  
nosed Sturgeon and the Loggerhead Turtle.

10. In the Site Background and History section, a discussion of adjoining properties should include the former steam plant north of the CHS site (now Luden's Marine). The power plant signed a "grant of easement" with a warehouse company north of the plant. The easement addressed the casting of "cinders, smoke, soot, and dust" into the air. The power plant could be an additional source of PAH's. Section 1.2.1 Line J
11. The discussion of surrounding sites inaccurately describes SCDHEC investigations. The SCDHEC SSI addressed one site, the Calhoun Park/Alexandriaborough Homes/Coal Gas site, SCD 987 581 337. Section 1.2.1
12. The Regional Setting section of the report discusses the presence of a laterally extensive aquitard. The well at the former MGP and the well at the former lumber yard may be sources of aquifer interconnection. The ERS considers all interconnections within two miles of the site. Section 1.2.3
13. The section on Area Groundwater Use does not accurately describe the sampling SCDHEC has conducted at the City of Mount Pleasant well. The sampling conducted during the SCDHEC SSI included a sample of only one well. Routine SCDHEC sampling by the Bureau of Drinking Water Protection is usually a composite of the entire system and is not good data for the ERS. Section 1.2.3
14. The section discussing contamination of surface soil does not take into account several factors critical to the ERS. Surface soil for ERS purposes is defined as 0 to 2 feet in depth. Also, one of the main contaminants of concern at the neighboring site is benzo(a)pyrene. The 1992 Superfund Chemical Data Matrix lists the cancer risk for benzo(a)pyrene at 80 ppb. The QL for the soil samples collected between 0 and 6 inches ranged from greater than 300 ppb to greater than 3000 ppb. Contamination significant to the ERS could have been undetected during this investigation. Section 2.0
15. Soil sample results are compared to several different concentration ranges including "typically naturally occurring ranges", and levels found at other industrial sites. The source of this information is not given. Concentrations of contaminants on-site should be compared to a site specific background or control sample when these types of samples are available. Two background or control samples were collected during the SCDHEC SSI of the neighboring site. The depth of sample collection and soil type should also be considered in the comparison. Section 2.0



16. The section discussing soil at the water table mentions that impact could have migrated to the site via runoff. The impact could also be due to direct deposition of waste at the CHS site at the time it was still open water/marsh. MGP's generated large amounts of waste that could not be reused, including sawdust that was used to filter out impurities from the gas. Some of the sawdust found during borings at the CHS site could be from deposition of this wastewater from the MGP.

Section 1.2.2

17. Additional sampling of the water and sediment from the Cooper River is needed to determine whether there has been a release of contaminants from the NPS site to the river. Samples should be collected during an ebbing tide; the tidal stage should be noted at the time of sampling.

Section 2.0

For risk assessment purposes, surface water and sediment should be sampled at statistically-chosen locations between the site and target areas such as Shutes Folly (a fishery area that has been impacted by PAHs), to determine whether the site has impacted ecological receptors.

RI/FS Work  
Plan

18. The comparison of sediment samples and soil samples is not an accurate comparison and should not be used. The sample analysis should be compared to media specific background or control levels, and evaluated on whether or not the levels are three times higher than the background or control levels.

Section 2.0

19. A better description of sample location should accompany the report, including sample depth, type of soil or sediment, and any nearby influences. The location of SD-04 could be near another drainage culvert and could represent a control sample for runoff.

Section 2.0



have to be taken to avoid adverse effects to biological receptors in the adjacent surface waters. SCDHEC has established a classification of GB for these groundwaters.

4. Investigations at the NPS site must be coordinated with investigations at the Calhoun Park/Ancenborough Homes/Coal Gas Plant Site.
5. While other sources of contamination may exist in the Cooper River estuary, this fact does not obviate the need for an evaluation of site effects on the aquatic/marine community, or an evaluation of possible human exposure through ingestion of contaminated seafood.
6. One potential source of impact on the site that was not mentioned in the report is the actual fill that was used to create the site. Several times during the field work drilling was halted by the presence of impenetrable fill; this fill may include refuse and wastes from adjacent properties. The nature of filling activities would dictate that the presence and distribution of any source areas as a result of filling would be difficult to define; potential source areas could be at land surface, at the water table, or at several different depths.
7. A risk assessment is needed to quantify the potential impact of the site on human health and the environment.

C. Specific Section Comments

1. Executive Summary

a. Page v, Paragraph 4

(1) The statement that "...except for localized areas, the soils at land surface are not significantly impacted" is made based on six surface soil samples that were collected during the study. Of these, four samples contained significant levels of PCBs and five out of the six samples contained significant concentrations of lead. The PCB contamination appears to be widespread over the northern two-thirds of the site, and lead contamination appears pervasive.

(2) Another statement made was "No pure wastes (free product) were identified except in one monitoring well located on the northern site boundary. When removed from the well, however, the free product did not reenter the well in measurable volumes. This indicated that it is present in only small volumes in this area." The migration of free product into a well is controlled by several factors, including capillary pressure, porosity of the zone in direct contact with the well screen as well as interfacial tension between the different





liquids. At other sites, unsuccessful attempts have been made to remove Dense Nonaqueous-Phase-Liquids (DNAPL) in wells by pumping. It is possible that free product exists in the vicinity of the referenced well. Other field observations also suggest that free product may exist on the proposed aquarium site, although its migration to available monitoring wells may again be restricted.

Significant thickness of free product was found in a monitoring well located on the northern site boundary. The fact that free product did not reenter the well in measurable volumes in the short time of observation does not justify the conclusion that free product "...is present in only small volumes in this area." Further justification would be needed for that conclusion.

b. Page vi, Bullet on Ambient Air

The report states that "the contaminants are not volatile and do not pose a vapor phase hazard." While observing the drilling at MW-11, a noxious creosol-type odor was observed as the augers were removed from the ground. Although no air monitoring was done at the time, it is likely that a vapor phase hazard was present and could be present again, should any excavation activities occur in the vicinity of MW-11.

c. Page vi., Bullet on Surface Water

A route for direct exposure to humans that was not discussed is dermal contact with surface water.

d. Page vii, Paragraph 1

(1) The executive summary interprets the data as indicating a widespread distribution of relatively low contaminant concentrations. However, total polynuclear aromatic hydrocarbons are high in samples from at least five of the nine locations where intensive soil sampling was conducted.

(2) The statement, "...remediation of the impact is neither technically feasible or justified..." is not supportable, since the impact to public health and the environment has not been adequately defined. Also, impacts are discussed throughout the report, e.g., Section I, paragraph 3.

e. Page vii, Paragraph 2

One primary migration pathway for contamination to reach the Cooper River is through groundwater to surface water discharge which likely occurs over the portion of the site adjacent to the river. Rerouting stormwater piping will assist in controlling stormwater impact, but will not effectively control groundwater to surface water discharge.



## 2. Section I. Introduction

### a. Page 1, Paragraph 3

The implication the EPA (1) has delayed the investigation and (2) will propose mitigation should be deleted. EPA has agreed to comment on NPS remedial investigation/feasibility study (RI/FS) work plans and reports whether or not the site is placed on the National Priorities List (NPL). However, if the site is not placed on the NPL, SCDHEC would have primary jurisdiction (except for possible emergency response). EPA will provide technical assistance in reviewing remedial action alternatives proposed by NPS.

### b. Page 6, Second Table

A review of the boring logs indicates that there is a wide variation in the lithology in the upper 80 feet of material at the site. A hydraulic conductivity of  $1.0 \times 10^{-7}$  is probably not representative of this material when considered as a unit.

### c. Page 7, Paragraph 2 (also related to Section IV.B., Pages 7-8)

One of the main concerns at this site is that contamination might reach the drinking water aquifer underlying the Cooper Formation. On one hand, the conclusion is stated that 200-foot-thick Cooper Formation is documented as an extensive aquitard throughout the area overlain by a 50-foot layer of "soft, plastic, and cohesive" sediments that should effectively close and seal and preferential pathways. On the other hand, contaminants were found as deep as samples were taken. Also, the impact of the wall drilled through the Cooper Formation in 1865 with an ungrouted annulus, the piles driven for the adjacent Dockside Condominiums, and any other possible penetrations needs to be discussed. Sampling of the lower aquifer would be needed to verify that the aquitard is effective and has not been penetrated.

The presence in the subsurface of a relict creek bed is an indication that vertical migration is likely to be occurring, even if in some parts of the site a relatively low permeability stratum is found. DNAPLs will move along gravitational gradients, in all likelihood towards the relict creek bed, which again in all likelihood breaches any shallow aquitard to be found elsewhere under the site.

### d. Page 8, Paragraph 1

A permeability of  $1.0 \times 10^{-7}$  for this site cannot be extrapolated to cover the entire site. Several boring logs indicate that sand was encountered during the entire boring. To confirm lithologic interpretations, grain-size analysis should be performed for selected intervals. Location S-1 may not be the single most representative sample location. Additionally, contamination in the unit termed an aquitard has



RS/B  
been confirmed indicating that the retarding qualities may not be as high as originally expected. Grain-size analysis and Shelby - tube sampling with vertical hydraulic conductivity tests should be performed at several locations selected to test the hypothesis that the material alleged to act as an aquitard in fact does so.

e. Page 8, Paragraph 2

No rationale is presented to explain how the top of the alleged aquitard was "picked". The reasoning and data supporting this conclusion needs to be presented.

f. Page 8, Paragraph 4.

The analytical QA/QC information submitted to EPA for validation in the form of seven notebooks of charts and data is being reviewed by EPA, and comments will be provided later. A concise description of QA/QC procedures and representative data or computerized data on diskette would be helpful.

3. Section V.A. - Surface and Subsurface Soil

A full scan Target Compound List/Target Analyte List (TCL/TAL) must be run on at least a portion of the sample from each medium and sampling interval. The full-scan samples for surface soil are needed to evaluate direct-contact exposure. Information on exposure pathways is an example of a request beyond the minimum required for an RSI, as discussed in the cover letter, but is needed for risk assessment.

4. Section V.A.i - Surface Soil - 0"-6"

a. Page 11, Paragraph 3

Chromium, barium and lead are also elevated at location S-1 in addition to arsenic and mercury.

b. Page 11, Paragraph 4

The data presented in this report are not adequate to make the conclusions presented in this paragraph. This document does not provide the data to make the statement that the surface soils on this site are not as contaminated as on surrounding sites. Since no volatile organic analysis was performed on the surface soils, the following statement is not appropriate: "These findings provide additional evidence that there is no apparent potential vapor phase hazard under ambient conditions."

5. Section V.A.ii. Soil at the Water Table (3'-4') Page 12, Paragraph 1

All metals are potentially elevated. However, in Table 5, arsenic, barium, cadmium, chromium, lead, mercury and possibly selenium are elevated. This report does not present data on background concentrations.





6. Section V.A.iii, Soil at the Interface with the Uppermost Aquitard Page 12, Paragraph 3

Aqueous-phase PAH transport in groundwater resulting in these concentrations is very unlikely. Separate-phase migration is a more likely occurrence. Direct deposit is another possibility.

7. Section V.A.iv - Soil 2'-5' into the Uppermost Aquitard and Section V.B-Groundwater

a. Page 13

The data presented on Table 9 indicates that the contamination has spread into the aquitard. Further sampling should be conducted to assess the potential for contamination of the deep aquifer. This is also important since the confining layer in the area of the site has been breached by the installation of a well (Appendix III, page 24).

b. Section V.A.iv, Page 13, Paragraph 4

Penetration of Metals, PCBs, and PAHs indicate clearly that the sequence termed "aquitard" is not preventing contaminant migration. The data does show that contamination is at least as deep as has been sampled.

8. Section V.B - Groundwater

a. Page 14, Paragraph 1

The groundwater/free product sample from MW-12 should have been analyzed for the complete TCL/TAL. This is important to identify the nature of the contaminants present.

b. Page 14, Paragraph 2

The groundwater data do not indicate that a small isolated area is contaminated with free product. The data do show that DNAPL was found in MW-12.

c. Page 14, Paragraph 2

The presence of DNAPL in MW-12 does not fit the hypothesis that contamination is flowing down the old drainage only. An additional source or an alternate hypothesis is suggested by this data.

d. Page 14, Paragraph 4

The statement that contaminants are migrating onto this site is not fully supported by the data. In most locations the soil and groundwater are both contaminated. While some migration from adjacent sites may be occurring, the data do not rule out the possibility of on-site sources.





e. Page 15, Paragraph 1

The fact that the facility is not being investigated because of contamination by total dissolved solids (TDS) should be made clear.

f. Page 15, Paragraph 2 (not counting table)

(1) All groundwater in the State is currently ranked as class GB, including the groundwater at the Charleston Harbor Site. Therefore, South Carolina Primary Drinking Water Regulations (R.61-58) apply. The classification of the groundwater at the site cannot be lowered to GC because one of the requirements for the GC classification is that "These groundwaters (GC) also must not migrate to GA or GB groundwater or have a discharge to surface water that could cause degradation." Discharge of contaminated groundwater to surface water is likely occurring at this site. In addition, according to the preface of the Water Classifications and Standards, R61-68, "Present classification procedures require a public hearing process, approval by the Board of the Department of Health and Environmental Control, approval by the General Assembly, and publication in the State Register." Therefore, downgrading the groundwater classification at the referenced facility would involve a lengthy and complicated administrative process.

(2) The groundwater in the shallow aquifer does not exceed the EPA criteria of 10,000 ppm TDS for designating groundwater non-potable.

(3) The designation of a particular aquifer as potable is not the prerogative of NPS or a private contractor, but falls within the jurisdiction of the regulatory agencies.

g. Page 15, Second bullet

MW-5 is less contaminated than MW-3 or MW-9. If contamination were only flowing preferentially through the old canal, MW-5 should also be contaminated. Additionally, the ground water contour maps on figure 6 do not support a depression in the water table along this location.

h. Page 15, Third bullet

The exact location of the Fernoline Chemical Company relative to this site and investigation is not presented. Additionally, MW-3, MW-9, and MW-10 are all on the southern portion of the property, and they are all revealed contamination, even though less than MW-1.

i. Page 16, Paragraph 1

The distribution of metals does not correspond to the distribution of organics. This strongly suggests that an



alternate source is acting on this site. An alternate source to the manufactured gas plant would also explain the metal and organic contamination detected on the southern portion of the site.

j. Page 16, Paragraph 1

The report states that impact is migrating to the site in groundwater because polynuclear aromatic hydrocarbons are present at the water table but absent at land surface. However, there may be additional sources of contamination within the fill, below ground surface and above the water table. Furthermore, as the water table itself is contacting fill that may contain contaminants, one source of contamination may be the Charleston Harbor Site. There remains the possibility that a portion of the observed contamination migrated on-site from an off-site source.

k. Page 16, Paragraph 2

One likely source for the observed lead contamination in groundwater samples from MW-3 and MW-9 is contaminated soil in the vicinity of the wells. If the source of contamination was runoff from the road, samples from MW-1 and MW-2 should also have high lead concentrations. The probable source for the PCB contamination observed in the groundwater would be the PCB contamination observed in the soils. Also, lead and mercury are not the only elevated metals in the groundwater.

l. Page 16, Paragraph 3

(1) Because PCB's have low solubilities, their presence in groundwater is of concern; particularly the presence of 4.91 ppb in water from MW-10. This concentration is approximately ten percent of the solubility of the PCB in question. The DNAPL paradigm presented by Dr. John Cherry in 1991 suggests that if one to five percent of the compound solubility is detected in a groundwater sample, a potential for DNAPL exists. The presence of PCB concentrations that are ten percent of the compounds solubility is a strong indication of the presence of a separate phase of DNAPL that contains PCBs.

(2) A likely contaminant source for the metals and organics is not known. It appears that more than one source is probable.

(3) Page 16, Paragraph 3

If metal contamination was from overland flow, the surficial soils would be more contaminated at the suspected source south of the site. However, S-1 is just as contaminated as those sampling locations south of the site. Additionally, the subsurface soil contamination is very wide spread.



m. Page 16, Paragraph 4  
PCBs were detected at least 7 locations in different media across the site. These are not "isolated occurrences".

n. General

Additional soil sampling for PAHs, metals and PCBs should be performed in the vicinity of MW-11. The worst possible case of soil contamination in that area is not known.

10. Section V.C - Surface Water and Sediment

a. General (Page 16-18)

This section should discuss the purpose of collecting a sediment sample 3/4 mile downstream from the site. It should also discuss the relationship of this sampling with the SCDHEC Coastal Toxics Monitoring Network and the Charleston Harbor studies (Appendix III, pages 29-32). The data gaps resulting from a lack of complete TCL/TAL analysis should also be discussed. Although it is agreed that the primary migration pathway to the river is most likely the drainage easement, ground water discharge to surface water should be discussed in this section.

In view of the Cooper River contamination that appears to be related to the NPS site and the nearby Calhoun Park/Ansonborough Homes/Coal Gas Plant Site, more information is needed to determine the extent of contamination. Sample location SD-4 is located too far downstream to be able to make a determination about downstream contaminant migration at this time. It is recommended that additional surface water and sediment samples be collected closer to the NPS Charleston Harbor Site (e.g., between the two docks at the northern and southern site boundaries). Information on physical properties of the river (e.g., water column depth, bottom type, tidal regime) can also be used in determining appropriate sampling locations.

For risk assessment purposes, information will be needed on surface water quality parameters (e.g., temperature, Ph, dissolved oxygen, salinity) and sediment parameters (e.g., grain size, total organic carbon). Surface water data should be compared to the appropriate South Carolina surface water quality standards, national Ambient Water Quality Criteria, and the U.S. EPA Region IV Waste Management Division's screening values for surface water. Likewise, sediment data should be compared to the Region IV screening values for sediment. Because groundwater may be discharging to surface water, groundwater data should be compared to these criteria as well as to drinking water standards.





b. Page 18, Bullet 1

The report indicates that the location of SD-3 and SW-3 are upstream from the northern edge of the site. However, when interpreting data from these samples, the following statement is made: "If significant impact were migrating to the river via groundwater discharges or overland surface water runoff, it would be reasonable to expect that this sample would have been impacted." Because this sample was taken upstream, any impact to the sample would be a result of mixing caused by flood tides; lack of contamination in this sample does not support the interpretation that discharge of contaminated groundwater from the site is not occurring. The potentiometric surface of groundwater in the vicinity of the former manufactured gas plant should be used to substantiate that contamination from the plant could have impacted the vicinity of SD-3/SW-3.

c. Page 18, Bullet 2

The report states that "The highest contaminant concentrations were detected in SD-1 which was collected near the southern end of the site where no impact from PAHs has been identified in the subsurface soils or groundwater. This shows that the impact in SD-1 was not the result of impacted groundwater seeping into the river..." Total PAH concentrations at the water table/soil sample in MW-10 were reported as 6100 ug/kg. This is the sampling location closest to SD-1; this data does not support the interpretation that was provided. Furthermore, groundwater, as observed in MW-9 and MW-11, contains high levels of contaminants which likely discharge to surface water. This discharge of contamination, which may occur upstream of SD-1/SW-1, may impact the surface water and sediment as it is transported in the river. In fact, because a sediment sample likely reflects a time-averaged absorption value, higher levels in sediment samples relative to water samples are not unexpected.

d. Page 18, Paragraph 1 (Below Bullets)

The statement that "The elevated concentrations of metals and PCBs in SD-2 compared to soils on the CHS indicate that the source of metals is not the CHS..." is not supported by the data which indicate lead concentrations at S-9 were as high as 340 mg/kg; at S-10 they were as high as 539 mg/kg; lead was detected in the groundwater



at 162 ug/l at MW-9 and 216 ug/l at MW-10. The data suggest that the site may be acting as a source of lead contamination.

11. Section VI. - Exposure Pathways

a. Page 18

"Dermal exposure to contaminants contained in soils or water" is correctly flagged as a potential human exposure pathway. As indicated in the letter from General Engineering Laboratories, additional precautions must be taken in the future to protect workers at the site from this exposure pathway.

b. Page 19, Paragraph 2

The assumption that a child would consume 0.2 grams of soil per day is the upper-bound value for soil and dust ingestion; it does not consider, as the document states, an unusually active (pica) child. If the groundwater associated with the site is classified as potable then the appropriate groundwater pathways should be considered.

c. Page 19, Paragraph 5

The report correctly notes that "periodic ambient air monitoring should be performed during excavation."

d. Page 20

The last statement, "Efforts to minimize continuing discharges to the river would be appropriate" is not strong enough. Efforts to minimize discharges of both groundwater and surface water from the site are absolutely necessary.

12. Section VII., Mitigation and Containment, Page 20 (Also related to Section VIII. Conclusions)

Although closing the drainage way to the Cooper River would shut off one source of contamination of the Cooper River, it would not control one of the main sources of contamination which is groundwater-to-surface-water discharge. The Charleston Harbor site, in conjunction with nearby site, is likely serving as a source of the contamination. While removal of the stormwater piping from the NPS Charleston Harbor Site would reduce contaminant migration via the



pipeline, a potential would still exist for contaminant migration via natural groundwater flow, with possible subsequent discharge of contaminants into the Cooper River. This pathway should be addressed.

13. Section VIII. - Conclusions

a. Page 21, Paragraph 2

Short term exposures resulting from performing subsurface excavations are considered acute rather than chronic. This section should also include discussion on the breached confining layer below the site.

b. Page 21, Paragraph 4

This statement overlooks the fact that periodic ambient air monitoring is necessary during excavation at the site to guard against the potential exposure pathway of breathing volatile contaminants.

c. Page 21, Last Paragraph

Please delete the statement on acknowledgement by EPA regarding technical feasibility. EPA has not received any proposal for remediation. In fact, the entire paragraph should be deleted, since discussion of remediation is not appropriate prior to a feasibility study.

14. Tables

a. Tables 3 and 4

The concentration of PCB-1248 in sample S-1 on Table 3 is 88800 ug/kg and on Figure 8 the total PCBs at land surface is 88000; this discrepancy should be resolved. Figures 8 & 9 should include units.

b. General

- (1) Documentation of the time surface water samples were collected in conjunction with tidal tables for the day of collection should be submitted to substantiate whether flood or ebb conditions predominated during sampling.
- (2) For all data tables in the main body of this report, include the detection limits (or minimum quantitation limits) for all non-detected chemicals. (This would be more efficient than having to search for these limits in the



appendices.) This information is especially important for comparing the data to ecological screening values, since concentrations of concern might be lower than the detection limits used for this study.

c. Tables 3, 4, 5, 6, 7, 8, 9 and 10

Analytical summary tables for soil quality at MW-11 do not include all compounds that were detected, according to the laboratory data sheets. Furthermore, the quantities of total tentatively-identified-compounds and mercury reported in the summary charts do agree with the laboratory data sheets. These discrepancies should be modified.

d. Table 3

Control or background soil samples should have been collected at the same time as the onsite sample collection.

In the footnote to this table, change the Appendix number from IV to III, for SCDREC's Site Screening Investigation containing the background surface soil data.

e. Table 12

The data given for mercury in groundwater are incomplete; part of the problem stems from using the units mg/l rather than ug/l. According to the Certificates of Analysis in Appendix X, mercury was found in groundwater wells MW-1 (0.010J ug/l), MW-2 (0.060J ug/l), MW-3 (0.700 ug/l), and MW-9 (0.840 ug/l). The detection limit was 0.500 ug/l. This should be corrected.

f. Table 13

The same comment applies for mercury in surface water and sediment samples. Show all detected values, including J data.

15. Figures

a. Figure 10

The data from mercury should be corrected. (See comment given above for Table 12).





b. General

- (1) All figures should include the directional location of sampling point SD-4 and the distance to that sampling point off of the figures.
- (2) More maps with isopleths would be helpful in visualizing distribution of contaminants.
- (3) An additional map with a scale between 1 inch = 2000 feet and 1 inch = 80 feet would be helpful to show the full extent of the Calhoun Park Area Site and vicinity. Contours for the groundwater table and the uppermost aquitard for the whole area could be shown.

D. Typographical Errors

1. Section I. - Introduction - Page 1  
National Priorities List (rather than priority).
2. Section I. - Introduction - Page 2  
The 1967 and 1981 photographs mentioned were not in the appendix as stated.
3. Section III.C. - Page 3  
Ambient Air - The 7th line contains a typographical error.
4. Section V. - Page 12  
References to Tables 5 and 6 appear to be reversed.
5. Section V.B. - Groundwater - Page 15, first paragraph, line 5  
TDS concentrations are shown in Table 12, not Table 9, as cited.
6. Table 7  
This table should include footnote "B."

Comments on the SCDHEC Memorandum of August 28, 1992, Regarding Field Oversight and the Response by General Engineering Laboratory

1. General

EPA had planned to provide field oversight of the ESI, including splitting samples and providing spiked and blank samples after the work plan was finalized. However, field work began before such finalization. SCDHEC was able to mobilize at least limited oversight in August 1992. SCDHEC



prepared a memorandum, dated August 28, 1992, on the oversight and noted several concerns. General Engineering Laboratories (GBL) prepared a response to the SCDHEC concerns for NPS, and NPS requested EPA to comment on the response.

2. Cooperation

Complete cooperation with, respect for, and responsiveness to regulatory personnel by NPS and contractor personnel during field oversight is essential. This is not only important to good working relationships but can affect confidence in results.

3. Further Explanation of Field Observations

NPS needs to provide additional explanation on the observation of free product, silver sheen and odor by SCDHEC, including SCDHEC laboratory testing related to the observations.

4. Integrity of Well MW-11 (DHEC Well MW-12)

- a. Bridging -- In some locations in unconsolidated sediments it is almost impossible to avoid having native soils collapse against a well screen installed through a hollow stem auger. This can lead to greater turbidity than would be found if the engineered sand pack was adequately placed around the screen. We would note, however, that extensive development of the well could still be used to minimize the amount of turbidity introduced into the well during sampling.
- b. Length of Well Screen -- For screening purposes, the use of the 20-foot screen was proper to intersect all zones potentially containing free product. Additional wells with shorter screens may be needed at a later date if it becomes necessary to isolate particular zones of contamination.
- c. Need for Additional Soil Sample (Split Sampling) -- While a split sample would have been useful for comparing results from different laboratories, the reasons stated for not collecting an additional sample from an unknown depth off the auger flight are understandable. Future field work should include plans for split sampling and analysis of blanks and spikes provided by the regulatory agencies. A sample from the highly impacted zone in MW-11 should be selected to determine the worst possible conditions.



5. Grouting

We agree with the GEL decision to grout the wells and boreholes with a single batch of grout after allowing adequate time for the bentonite seal to hydrate.

6. Site Safety

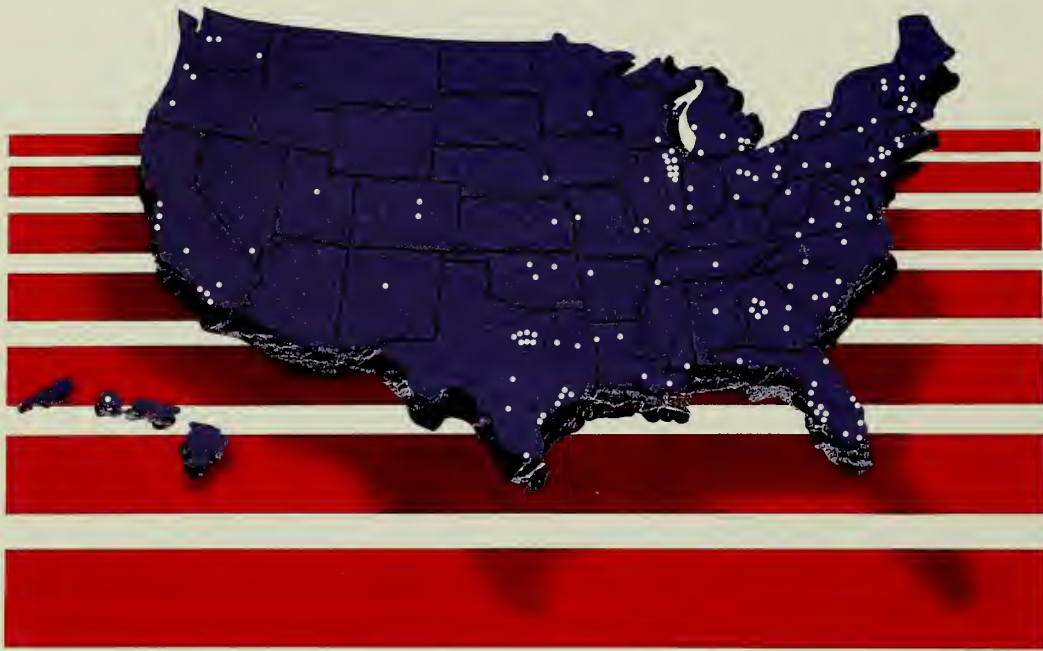
DREC was well justified in pointing out the concerns raised for the safety of personnel of the drilling crew. Adequate "ice pack" vests and adequate back up personnel must be provided in the future. This will minimize the possibility that the drilling crew must choose between heat related fatigue and wearing adequate protective clothing. Air monitoring and the use of adequate protective clothing are essential in this type investigation.







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